U.S. DEPARTMENT OF COMMERCE
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PB-272 325

Determining Input Variables for Calculation of Impact of New Source Performance Standards: Worksheets for Food and Agricultural Industries

Research Corp. of New England, Wethersfield, Conn

Prepared for

Environmental Protection Agency, Research Triangle Park, N C

Apr 77

PB 272 325

EPA-450/3-76-018-c
April 1977

DETERMINING INPUT VARIABLES FOR CALCULATION OF IMPACT OF NEW SOURCE PERFORMANCE STANDARDS: WORKSHEETS FOR FOOD AND AGRICULTURAL INDUSTRIES

U.S. ENVIRONMENTAL PROTECTION AGENCY
Office of Air and Waste Management
Office of Air Quality Planning and Standards
Research Triangle Park, North Carolina 27711

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PB272325

TECHNICAL REPORT DATA

(Please read Instructions on the reverse before completing)

1. REPORT NO. EPA 450/3-76 - 018c	2.	3. RECIPIENT'S ACCESSION NO.
4. TITLE AND SUBTITLE Determining Input Variables for Calculation of Impact of New Source Performance Standards: Worksheets for Food and Agricultural Industries		5. REPORT DATE April 1977 6. PERFORMING ORGANIZATION CODE
7. AUTHOR(S) Thomas G. Hopper William A. Marrone		8. PERFORMING ORGANIZATION REPORT NO.
9. PERFORMING ORGANIZATION NAME AND ADDRESS TRC - The Research Corporacion of New England 125 Silas Deane Highway Wethersfield, Connecticut 06109		10. PROGRAM ELEMENT NO. 2AC129 11. CONTRACT/GRANT NO. 68-02-1382
12. SPONSORING AGENCY NAME AND ADDRESS EPA-Office of Air Quality Planning and Standards Emission Standards and Engineering Division Research Triangle Park, NC 27711		13. TYPE OF REPORT AND PERIOD COVERED Task Final; 7/74 - 7/76 14. SPONSORING AGENCY CODE EPA - OAQPS

15. SUPPLEMENTARY NOTES

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16. ABSTRACT

The purpose of this document is to present the results of a study to determine the impact of new source performance standords on nationwide emissions. The work presented covers 14 potential pollutants from approximately 200 source categories for the year 1985. The results are being used by EPA as input to the development of an overall standard setting strategy. The report contains information regarding controlled and uncontrolled emission factors, State emission limitations, industrial capacity, utilization, growth and retirement rates. The results of this study have been published as three volumes which encompass ten separate documents. The document contains Appendix AC of Volume II - Calculation Sheets for the Food and Agricultural Industry.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS		c. COSATI Field/Group
Air Pollution Air Pollution Control Industrial Processes Combustion Regulations Economic Factors	Priorities Chemical Industry Paper Industry Petroleum Industry	Metal Industry Agricultural Mineral Flyash Exhaust Gases	

18. DISTRIBUTION STATEMENT Unlimited	19. SECURITY CLASS (This Report) Unclassified	21. NO. OF PAGES 197
	20. SECURITY CLASS (This page) Unclassified	22. PRICE PC A09/MF A01

EPA Form 2220-1 (9-73)

☆ U.S. GOVERNMENT PRINTING OFFICE: 1977-745-118/318 REGION NO. 4

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by

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Contract No. 68-02-1382

EPA Project Officer: Gary D. McCutchen

Prepared for

U.S. ENVIRONMENTAL PROTECTION AGENCY
Office of Air and Waste Management
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April 1977

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Publication No. EPA-450/1-76-018-c

FOREWORD

During 1974, two studies were initiated that ultimately resulted in the establishment of priorities for developing and promulgating New Source Performance Standards (NSPS). The procedures used to determine these priorities produced a great deal of information that is believed to be useful in the industries involved and, accordingly, is being published in this series of reports (EPA-450/3-76-017, EPA-450/3-76-018, EPA-450/3-76-019, and EPA-450/3-76-020). This information is organized as follows:

EPA-450/3-76-017 discusses (1) the mathematical model (Model IV) used to determine NSPS impacts over a 10-year period; (2) the methods used to attain input variables; and (3) the summary tables which are the heart of this study. Included in the summary tables are data related to (1) emission, growth, and replacement rates; (2) present and future production and capacity; (3) nationwide emissions; and (4) NSPS impact. These tables include information on 13 pollutants and nearly 200 stationary source categories.

EPA-450/3-3-76-018-a, -b, -c, -d, -e, and -f are the calculation sheets, showing how the input vairables reported in EPA-450/3-76-017 were derived. All information sources, assumptions, and calculations are documented and explained. The appropriate worksheets are arranged alphabetically in the following volumes:

018-a - Stationary Combustion Sources

018-b - Chemical Processing Industries

018-c - Food and Agricultural Industries

018-d - Mineral Products Industries

018-e - Metallurgical Industries

018-f - Miscellaneous Sources (Evaporation Losses, Petroleum Industry, Wood Products Industry, and Assembly Plants

The 018-a -f series is of interest only to those concerned with the detailed calculations used to determine the Model IV input variables.

EPA-450/3-76-019-a provides additional results and information produced during the priority study. Its major purpose is to describe the computer program used to rank all the Model IV input and output variables by pollutant (these rankings are reported in 019-b and -c). In addition, it contains (1) summaries of the control systems considered "best" for each source, (2) equipment retirement ages, and (3) emission trends for each source category.

EPA-450/3-76-019-b and c present the computer-generated ranked data for each pollutant. Ranking is from highest to lowest for each of the 21 variables, e.g., A (nationwide capacity) and Eu (uncontrolled emission rate). Volume 019-b contains ranked data for particulate, nitrogen oxide (NOx), and sulfur oxide (SOx) sources. In Volume 019-c, the remaining pollutant sources are ranked: hydrocarbons, carbon monoxide (CO), fluorides, hazardous material, acid mist, lead, ammonia, sulfides, chlorine, and trace metals.

EPA-450/3-76-020, the final document in this series, takes the objective impact values from EPA-450/3-76-017, adds subjective judgements, and uses these combined criteria to produce a priority list for NSPS development. The report then calculates nationwide emission trends over the next 15 years for each criteria pollutant (particulate, SOx, NOx, hydrocarbons, and CO) based on a series of scenarios (e.g., no NSPS, 20 NSPS per year, etc.)

In summary, documents EPA-450/3-76-017 and 020 present the results of this study. Each stands alone, but they also complement each other, with 020 building on the results of 017. The remaining documents (018-a -f and 019-a -c) present additional and/or more detailed information derived from the impact and priority studies.

DETERMINATION OF INPUT VARIABLES
FOR
THE FOOD AND AGRICULTURAL INDUSTRY

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Project Number – 32391 New Source Performance Standards

Computation Sheet For Industrial Factors

Calculations Done By W. Marrone Date 11-27-74

Source Cotton Ginning

Pg 1

Ref. 011 p1-2

"Because of the number and complexity of all factors influencing the cotton market the National Cotton Council finds it impossible to project the future of cotton even one year."

"Production will remain in the range of 9-14 million bales/yr for the period 1970 to 1980.

A historical look at cotton production also points to the problem of estimating growth. (Ref. [illegible])

1899	9.4×10^6 bale/yr	29,600 Gins
1969	10.0×10^6 bale/yr	3,993 Gins
1970	10.1×10^6 bale/yr	3,784 Gins

Over the 70 year period the cotton output stayed approximately the same and the number of gins has decreased remarkably. This is explained by an increase in the size of the typical gin attributed to mechanization and demanded by economics.

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Computation Sheet For Industrial Factors

Calculations Done By J.J. Morrone Date 11-27-74

Source Cotton Ginning

P_c : cont'd

Our estimate of growth in the cotton ginning industry will be based on the following development.

① 1970 production = 10.1×10^6 bales/yr

② 1980 production is estimated as the average of the 9 to 14 $\times 10^6$ bale/yr range quoted above

③ Growth from 1970 to 1980 is assumed simple and based on the above data (1975 as baseline year)

$$P_{80} = \frac{9+14}{2} = 11.5 \times 10^6 \text{ bales/yr}$$

$$P_{70} = 10.1 \times 10^6 \text{ bale/yr}$$

$$\underline{\text{Growth}} = (11.5 - 10.1) \times 10^6 \text{ bale/yr}$$
$$= 1.4 \times 10^6 \text{ bale/yr}$$

$$\underline{\text{Yearly growth}} = \frac{1.4}{10 \text{ yrs}} \times 10^6 \text{ bale/yr} = .14 \times 10^6 \text{ bale/yr/yr}$$

$$P_{75} = 5 \times (.14 \times 10^6) + P_{70} = (.7 + 10.1) \times 10^6 \text{ bale/yr}$$

$$P_{75} = 10.8 \times 10^6 \text{ bales/yr}$$

then $P_c = \frac{.14 \times 10^6}{10.8 \times 10^6} \approx .013$ simple

$$\therefore \left(P_c = .013 \text{ simple} \right)$$

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Project Number - 32391 New Source Performance Standards

Computation Sheet For Industrial Factors

Calculations Done By W. Marrone Date 11-27-74

Source Cotton Ginning

K:

Cotton gins are operational for very short periods generally encompass the normal cotton harvesting period. This usually is only 4-6 weeks in time. This implies that gins are inactive 46-48 weeks out of the year. It is expected that gins are designed to handle a certain ginning rate and if production peaks above capacity then the length of the ginning period will be increased accordingly. All of this is to say that when gins are running they are producing a the peak design rate and for this reason the capacity utilization ratio is assumed equal to unity

$$\boxed{K = 1}$$

A: Using $P_{75} = 10.8 \times 10^6$ bales/yr and $K = 1$

$$\boxed{A = 10.8 \times 10^6 \text{ bales/yr}}$$

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Project Number - 32391 New Source Performance Standards

Computation Sheet For Emission Factors

Calculations Done By W. Marrone Date 11-27-74

Source Cotton Ginning

Particulates

E_u: Ref 075 Table 6.3-1

$$\boxed{E_u = 12 \text{ lb/bale}}$$

use total emissions disregarding fallout effect.

Breakdown given:

① unloading 5
② cleaner 1
③ stick/burr 3
④ misc. 3
12 lb/bale

E_N: Ref 011 p4-2

99+% eff on high pressure system (unloading, cleaner, stick and burr, misc etc) achieved through use of small diameter (ARC) cyclones.

Ref 011 p4-4

overall eff of 87% on low pressure system (lint cleaner and waste) with inline filter

These are considered best available control systems

We assume ① 99% eff on high pressure (5+1+3) 9 lb/bale
② 87% eff on low pressure (3) = 3 lb/bale

$$E = .01 \times 9 + .13 \times 3 = .09 + .39$$

$$\boxed{E_N = .48 \text{ lb/bale}}$$

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Project Number - 32301 New Source Performance Standards

Computation Sheet For Emission Factors

Calculations Done By W. Marrone Date 11-27-74

Source Cotton Ginning

Particulates

E_s:

The process weight necessary to produce 1 bale (500 lbs) of cotton is as mentioned in Ref 075 p 6.3-1 is about 2000 lb or 1 ton

Ref 011 pg 1-4 specifies a typical gin size of 10-15 bales/hr with an average of 12.5 bales/hr

$$12.5 \frac{\text{bales}}{\text{hr}} \times 2000 \frac{\text{lb input}}{\text{bale produced}} = 25\,000 \frac{\text{lb input}}{\text{hr}}$$

Ref 011 pg 1-6 Table 1 gives 1968 Gin breakdown by state from which we may estimate state-wide capacity distribution

	No of Gins	P_i	Allowable lb/hr
Alabama	339	.081	17.3
Georgia	255	.061	22.4
S Carolina	224	.054	22.4
N. Carolina	143	.034	22.4
Virginia	7	.002	22.4
Florida	5	.001	17.3
Louisiana	181	.043	22.4
Arkansas	451	.108	17.3
Miss	511	.123	22.4
Tenn	23	.006	17.3
Missouri	115	.028	22.4
Kent	1	neg	22.4
Texas	1300	.312	31.5

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Computation Sheet For Emission Factors

Calculations Done By R.J. Marrone Date 11-27-74

Source Cotton Ginning

	No. of Gins	P_i	Allowable lb/hr
Oklahoma	145	.035	22.4
Arizona	116	.028	22.4
California	291	.070	22.4
New Mexico	58	.014	20.0
Nevada	1	neg	22.4
	4166	Σ 1.00	

$$E = .312\,(37.5) + .014\,(20.0) + .196\,(17.3) + .478\,(22.4)$$

$$11.7 + .28 + 3.39 + 10.71$$

$$E \cong 26.1 \text{ lb/hr}$$

$$E_s = \frac{26.1 \text{ lb/hr}}{12.5 \text{ bale/hr}} = 2.09 \text{ lb/bale}$$

$$E_s = 2.09 \text{ lb/bale}$$

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Project Number - 32391 New Source Performance Standards

Computation Sheet For Emission Factors

Calculations Done By R.J. Massaro Date 5-15-75

Source Cotton Ginning

Arsenic – (hazardous pollutant)

arsenic emissions from the ginning operation only may be estimated from data in Ref. (7) pg (24)

.03% of emitted particulate near gin was found to be arsenic.

pg 25 of the same reference suggests that particulate control measures should be adequate at controlling arsenical emissions.

We will develop the emission factors for arsenic E_U, E_S, E_N by using the appropriate particulate factors and assume the .03% relationship applies to uncontrolled, controlled, and allowable. This assumes "de facto" control of arsenic from cotton ginning through imposition of particulate regs.

$E_{UA}(\text{arsenic}) = .0003 \times 12\ \text{lb/bale} = .0036\ \text{lb/bale}$

$E_N(\text{arsenic}) = .0003 \times .48\ \text{lb/bale} = .00014\ \text{lb/bale}$

$E_S(\text{arsenic}) = .0003 \times 2.09\ \text{lb/bale} = .00063\ \text{lb/bale}$

it is assumed that existing plants can achieve controls suggested by E_N

$(E_{111d} = E_N = .00014\ \text{lb/bale})$

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Computation Sheet For Industrial Factors

Calculations Done By Hoover Date 8/30/76

Source Ammonium Sulfate

Ammonium Sulfate is produced as a prime product and as a by-product of the following:

① Coke oven
② Caprolactam
③ Methyl methacrylate
④ Acid

K will be synthesized by weighting the K for each method by its relative contribution to total production.

Prod by prime = 1175.4 $\times 10^3$ tons (1966) Ref ⑨⑤ 708.5080 P
Cap of prime = 1432.6 $\times 10^3$ tons Ref ⑨⑤ 708.5080 F-L

$K_{prime} = 0.82$

Prod by caprolactam = 633.7 (1966) Ref ⑨⑤ 708.5020 P
Cap by " " = 850 Ref ⑨⑤ 708.5020 F-L

$K_{cap.} = 0.76$

Prod by coke oven = 746.5 (1966) Ref ⑨⑤ 708.5080 P
Cap. by coke oven = 820 Ref ⑨⑤ 708.5080 F-L

$K_{coke\ oven} = 0.91$

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Project Number - 32391 New Source Performance Standards

Computation Sheet For Industrial Factors

Calculations Done By [illegible] Date 8/29/74

Source Ammonium Sulfate

Prod. of Meth. Methyl/Meth. = 290×10^6 Ref (91) 606.1010 C
Cap of " " = 370×10^6 Ref (91) 606.5030 B
Aug '66

$K_{\text{Meth Meth}} = 0.78$

Prod of HCN = 146×10^3 T Ref (95) 735.5020 D Apr. '65
Cap. of HCN = 215.5×10^3 T Ref (95) 735.5020 B

$K_{\text{HCN}} = .68$

The above two were done for the entire plant (info for the Amm. Sulf. aspect was not available)

Total Amm. Sulf Prod (1966) = 2900×10^3 tons

By Prime	= 1175.4×10^3	—	40.9 %
By Coke	= 633.7×10^3	—	22. %
By [illegible]	= 746.5×10^3	—	26.0 %
By Meth Meth	= 290×10^3	—	10.1 %
By HCN	= 27×10^3	—	0.9
	2872.6		

$K_{AS} = (.409)(.82) + (.221)(.73) + (.26)(.91) + (.101)(.78) + (.009)(.68)$
$.34 + .17 + .24 + .08 + .01$

$K_{\text{Ammonium Sulfate}} = 0.84$

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Computation Sheet for Industrial Factors

Calculations Done By Hance Date 8/30/74

Source Ammonium Sulfate

Ref ⑼⑸ 708 5020 ⑤

Prod 1960 = 1500 x10^3 Tons
Prod 1966 = 2900x10^3 Tons

$$P_c = \sqrt[6]{\frac{2900}{1500}} - 1$$

.1667

$$P_c = \sqrt[6]{1.9333}$$

$$\boxed{P_c = 11.6\ \%}$$ compound

$$A = \left(\frac{2900 \times 10^3\,T}{0.84}\right)\left(1.116\right)^9 = 9270 \times 10^3\,T$$

$$\boxed{A = 9{,}270 \times 10^6\ \frac{\text{tons}}{\text{yr}}}$$

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Project Number - 32391 New Source Performance Standards

Computation Sheet For Industrial Factors

Calculations Done By William Marrone Date 9-26-79

Source Ammonium Sulfate

P_B: Ref 037 pg 33 Section 28.0

Fertilizers are covered under this category of chemical and allied products manufacture.

Asset Guideline Life 11 yrs

P_B 037 = 2 x AGL = 22 yrs

100% Depreciation in 22 years $\frac{100\%}{22 \text{ yrs}}$ or 4.5%/yr simple

P_B = .045 simple

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Project Number - 32391 New Source Performance Standards

Computation Sheet For Emission Factors

Calculations Done By ______________ Date 8/30/76

Source Ammonium Sulfate

Ref (49) p 326 Tab 15-1

E_U = 1% of product   This # was assumed by MRI & we have not located any data

$$E_U = .01 \frac{\#\ \text{Prod}}{\#\ \text{Prod}} \times 2000 \frac{\#\ \text{Prod}}{\text{Ton Prod}} = 20\ \#/\text{Ton}$$

$$\boxed{E_U = 20\ \#/\text{Ton}}$$

Since Ammonium Sulfate is produced as both a prime & by-product, no single collection device would be feasible for all operations due to the extremes in variability of the processes. However, the following info is helpful in selecting a "general" control device for the purpose of this study:

(1) Ammonium Sulfate Ref (49) p 329

"The dryer is usually controlled by cyclones or wet scrubbers"

(2) Ref (49) p 332 "Wet scrubbers are probably the most common piece of dust and fume collection equipment being used in fertilizer plants"

∴ We will choose a wet scrubber as the "general" control device

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Project Number - 32391 New Source Performance Standards

Computation Sheet For Emission Factors

Calculations Done By [illegible] Date 8/30/74

Source Ammonium Sulfate

Ref (91) (Dealing with the fertilizer industry)

Sec. X Tab. 30

Wet Scrubber efficiencies

$94\% < \eta < 99.8\%$

Ref (6) includes the following report

"Wet Scrubbers", Chem. Eng., Oct 14, 1968

which states

$\eta_{\text{wet scrubber}} = 95\%$ for phosphate dust from fertilizer plants

We will use, therefore, $\eta = 95\%$

$E_N = (0.05)(20) = 1 \text{ lb/ton}$

$$\boxed{E_N = 1.0 \text{ lb/ton}}$$

For E_S, the following are plant locations & capacity Ref (95)

V_A (575) 768,000 T-6

Tex 140 + 150 + 60 + 80 + 100 + 325 + 100

Calif. 90 + 80 + 150 + 290

Ga. 85

$\frac{2213}{3546} = 62\%$

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Project Number - 32391 New Source Performance Standards

Computation Sheet For Emission Factors

Calculations Done By Date 10/17/74

Source Ammonium Sulfate

Ammonium Sulfate

E3 DETERMINATION

This data (p2) is not a complete list - only 63% of the industry.

Typical plant size (weighted mean) = 146.6 x 10^3 tons/yr ⇒ 402 TPD (365 days)
⇒ 33,470 #/hr (8760 hrs)
(16.74 TPH)

Since AS is produced as a prime product & as the by-product of many other processes, it is difficult (if not impossible) to generate a standardized feed/product ratio. For the purpose of this study, we will assume a 1:1 ratio. This will result in a lower value of E_3 & therefore, a decline of the minimum expected impact ($T_1 - T_2$). Based on our experience with other calculations, the difference in E_3, on a #/ton basis, will be small.

For Va $\frac{575}{3346}$ = 17%
Tex $\frac{1003}{3346}$ = 30%
Calif $\frac{610}{3346}$ = 18%
Ga $\frac{65}{3346}$ = 2%

Assume all other plants equally dispersed around U.S. (37%)

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Project Number - 32391 New Source Performance Standards

Computation Sheet for Emission Factors

Calculations Done By [illegible] Date 10/18/84

Source Ammonium Sulfate

From Ref (19) P 29 TAB III & Ref (148)

$E_{S_{VA}}$ = 27 #/HR

$E_{S_{IEX}}$ = 50 #/HR

$E_{S_{BA}}$ = 27 #/HR

$E_{S_{TAL}}$ = 24.5 #/HR Ref 156 P 37 (1A AND)

Ferguson's PWR curve

$E_{S_{NUL}}$ = 26.0 #/HR

$E_S = (27)(.17) + (50)(.3) + (27)(.02) + (24.5)(.18)$
$+ (.37)(26.0)$

$= 4.59 + 15.0 + .54 + 4.41 + 9.62 = 34.16$ #/HR

$E_S = \dfrac{34.16 \text{ \#/HR}}{16.74 \text{ TONS/HR}} = 2.04$ #/TON

$E_{S_{PART}} = 2.04$ #/TON

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Project Number - 32391 New Source Performance Standards

Computation Sheet For Industrial Factors

Calculations Done By Date 9/4/74

Source Fertilizers - Diammonium Phosphate

Ref (95) p 760.5003 B

1973 Prod = 8.52×10^6 tons P_2O_5

Ref (95) p 760.5001 A

"The industry operated 'flat out' in 1973, resulting in an average total design capacity utilization factor of about 90%."

p 760.5003 A

1972 K = 87% - 91%

Ref (91) Sec VIII Page 1

$K_{1980} = \frac{4.60}{5.35} = 0.86$

Therefore, choose

$\boxed{K = 0.89}$

Ref (95) 760.5001 C

Avg annual growth rate 1972 - 1980

4.5 - 6.25% ([illegible] case)

Assume average = (4.5 + 6.25)/2 = 5.4%

$\boxed{R = 0.054}$

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Project Number - 32391 New Source Performance Standards

Computation Sheet For Industrial Factors

Calculations Done By [illegible] Date 9/4/74

Source Fertilizers -DAP

$$\frac{(2.52\times10^{6})}{(0.89)}\times\left[1+(.054)(2)\right]=3.14\times10^{6}\ \frac{\text{tons}}{P_2O_5}$$

$$\boxed{A = 3.14\times10^{6}\ \text{tons}\ P_2O_5}$$

Obsolescence rate for fertilizers is estimated as follows:

Ref 037 pg 37 Sec 28

Asset guideline period 11 yrs

P_b est = 2 × IRS = 22 yrs

$\frac{100\%}{22\text{ yrs}} \approx 4.5\%/\text{yr}$ simple

$$\boxed{P_b = .045\ \text{simple}}$$

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Project Number - 32331 New Source Performance Standards

Computation Sheet For Emission Factors

Calculations Done By [illegible] Date 9/11/79

Source Fertilizers - Diammonium Phosphate

Ref (78) p 6.10-1 PAR 6.10-1

E_{tp} = 82 #/ton

NO MENTION IS MADE OF THE PRODUCTION QUANTITY ASSOCIATED WITH THIS FACTOR. SINCE PRODUCTION IN THE INDUSTRY AS A WHOLE IS EXPRESSED AS EQUIVALENT P_2O_5, WE APPLIED [illegible] TO ASSUME SIMILAR.

E_{tp} = 82 #/ton P_2O_5

Ref (77) p 137 [illegible]

" . . . . WET SCRUBBING EQUIPMENT CONTINUOUSLY APPLIED FOR REMOVAL OF AMMONIA, FLUORIDES AND PARTICULATE DUSTS FROM EFFLUENT GAS STREAMS GENERATED AT DAP PLANTS "

Ref (77) p 147 E = 98%

E_{tp} = 1.64 #/ton P_2O_5

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Project Number - 32391 New Source Performance Standards

Computation Sheet For Emission Factors

Calculations Done By Hopper Date 9/4/79

Source Fertilizer - DAP

Ref (77) p 147 states NH_3 emission of

$8.0 \ \#NH_3 / ton \ P_2O_5$

$EU_{NH_3} = 8.0 \ \# / ton \ P_2O_5$

Same Ref, same page states

Eff = 99% for wet scrubber

$EC_{NH_3} = 0.08 \ \# / ton \ P_2O_5$

Read Fluorides

Ref (78) p 6.10-1 Tab 6.10-1

$EU_F = 0.04 \ \# / ton \ P_2O_5$

$EU = 0.04 \ \# / ton \ P_2O_5$

These are fluoride emissions from the dryer cooler which were not included in this work. Another source of data could be pursued.

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Project Number - 32391 New Source Performance Standards

Computation Sheet For Emission Factors

Calculations Done By Hopper Date 8/4/74

Source [illegible] -DAP

Ref (87) p 36

$.5 < E_U < .08$

Assume avg value

$E_U = (.5 + .08)/2 = 0.29$

$\boxed{E_U = 0.29\ \#/\text{ton } P_2O_5}$

Ref (33) p 41

$\boxed{E_{N_F} = 0.06\ \#/\text{ton } P_2O_5}$

$R = \frac{.29 - .06}{.29} = 79\%$

Der'n Of $E_{[illegible]}$

(A) Fluoride Ref (159) p 1-9 Tab 1-2

$\boxed{E_{[illegible]} = 0.06\ \#/\text{ton } P_2O_5}$ Fluoride

(B) Ammonia P2 of Chem eng's estimates R = 99% with a wet scrubber. This is based on a [illegible] situation. Thus

11 $E_{[illegible]} = E_U$ $\boxed{E_{[illegible]} = 0.08\ \#/\text{ton } P_2O_5}$ Ammonia

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Project Number - 32391 New Source Performance Standards

Computation Sheet For Emission Factors

Calculations Done By [illegible] Date 10/21/76

Source Fertilizers - Diammonium Phosphate

Determination of E_b

Procedures

No specific information exists to locate existing the geographical distribution of DAP plants. However we will assume that they are located in areas where phosphate rock is mined. Ref (92) p [illegible] indicates that 78% of the U.S. supply of phosphate rock is in Florida.

So, we will synthesize E_b based on weighting the Florida E_b's by 78% & using the generalized power weight curve for the remaining 22%

Ref (93) p 18 indicates a "typical" plant of 800 tons of P_2O_5

$$\frac{800\ \frac{\text{tons } P_2O_5}{\text{day}}}{\left(0.736\ \frac{\text{tons } P_2O_5}{\text{ton DAP}}\right)\left(24\ \frac{\text{hrs}}{\text{day}}\right)} = 45.29\ \frac{\text{tons DAP}}{\text{hr}}$$

$$= 90{,}579\ \text{lb/hr DAP}$$

From Ref (94) p 39 Fig III

$$E_{b_{\text{Fla}}} = 31\ \text{lb/hr}$$

From gen'l power curve

$$E_{b_{\text{power curve}}} = 39.8\ \text{lb/hr}$$

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Computation Sheet For Emission Factors

Calculations Done By [illegible] Date 10/18/74

Source Fertilizers - DAP

$$\frac{31\ \text{\#/hr}}{45.29\ \text{tons/hr}} = .6845$$

$$\frac{39.2}{45.29} = .8655$$

$$E_s = \left[(.73)(.6845) + (.27)(.8655)\right] \div .46$$

$E_s = 1.595$ #/ton P_2O_5

This is essentially the same as E_{a1}

However, Ref (95) p 760.5003A shows that there were 42 plants producing 2.52x10^6 tons of DAP (P_2O_5) in 1973

$$\frac{2.52 \times 10^6}{(42)(8760)} = 6.849\ \text{tons}\ P_2O_5/\text{hr}$$

Ref (95) p 760.5002 A indicates feed req'ts per ton of DAP

NH_3 Req = 0.245 tons/ton DAP
Phosphoric Acid (P_2O_5 basis) = .4875 ton/ton DAP (40-45% P_2O_5)
Sulfuric Acid = .012 ton/ton DAP

$$\frac{0.4875}{.425} = 1.147\ \text{tons}\ H_3PO_4/\text{ton DAP}$$

avg → .425

$1.147 + .245 + .012 = 1.404$ tons feed/ton DAP

From Ref (95) p 760.5001B, $\frac{2.319 \times 10^6\ \text{tons}\ P_2O_5}{5.04 \times 10^6\ \text{tons DAP}} = 0.46$

$$\frac{1.404\ \frac{\text{tons feed}}{\text{ton DAP}}}{.46\ \frac{\text{tons}\ P_2O_5}{\text{ton DAP}}} = 3.052\ \text{tons feed}/\text{ton}\ P_2O_5$$

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Computation Sheet For Emission Factors

Calculations Done By [illegible] Date 10/16/84

Source Fertilizers - DAP

$$PWR = 6.849\ \frac{\text{ton } P_2O_5}{\text{hr}} \times 2000\ \frac{\text{lb}}{\text{ton}} \times 3.052\ \frac{\text{tons feed}}{\text{ton } P_2O_5} = 41{,}806\ \frac{\text{\# feed}}{\text{hr}}$$

From Ref ㉛ per Tab. III & Ref (148)

$$E_{s_{FLA}} = 22\ \text{\#/hr}$$

From gen'l PWR curve,

$$E_u = 30\ \text{\#/hr}$$

$$E_s = (.73)\left(\frac{22}{6.849}\right) + (.27)\left(\frac{30}{6.849}\right) = 2.345 + 1.183 = 3.528$$

$$\boxed{E_{s_{DAP}} = 3.528\ \text{\#/ton } P_2O_5}$$

Ammonia

There are no State standards. Assume $E_s = E_u$

$$\boxed{E_{s_{NH_3}} = 8.0\ \text{\#/ton } P_2O_5}$$

Fluorides

Ref (148) Florida has a reg of 0.06 #/ton P_2O_5
Assume other States to be uncontrolled

$$E_s = (.73)(.06) + (.27)(.29) = .0438 + .0783 = 0.1221$$

$$\boxed{E_{s_{Fluorides}} = 0.122\ \text{\#/ton } P_2O_5}$$

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Project Number - 32391 New Source Performance Standards

Computation Sheet For Industrial Factors

Calculations Done By Hanna Date 9/3/74

Source Fertilizers Granulated Triple Superphosphate

Ref (95) p 760.4000B

Estimates

$$1975 \text{ Production} = \left(\frac{.860 + .930}{2}\right) \times 10^6 \text{ tons } P_2O_5$$

$$= 0.895 \times 10^6 \text{ tons } P_2O_5$$

Growth between 1975 and 1980 is

$$.895 \times 10^6 \rightarrow 1.100 \times 10^6$$

$$P_c = \sqrt[5]{\frac{1.100}{0.895}} - 1.0 = 4.2\%$$

$$\boxed{P_c = 0.042}$$ compound

Ref (95) p 760.4000B

States capacity utilization in 1976 to be

$$.72 \le K \le .8$$

Assume the average = 0.76

$$\boxed{K = 0.76}$$

$$A = \frac{.895 \times 10^6}{.76} = 1.178 \times 10^6$$

$$\boxed{A = 1.178 \times 10^6 \text{ tons } P_2O_5}$$

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Computation Sheet For Industrial Factors

Calculations Done By W. Marrone Date 9-26-74

Source Granulated Triple Superphosphate

P_B: Ref 037 pg 33 sec 28.0

Asset guideline period 11 yrs

P_B est = 2 × IRS = 22 yrs

$\frac{100\%}{22 \text{yrs}} = 4.5\% / \text{yr}$ simple

$$\boxed{P_B = .045 \text{ simple}}$$

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Project Number - 32391 New Source Performance Standards

Computation Sheet For Emission Factors

Calculations Done By Hanna Date 9/6/74

Source Fertilizers - Granulated Triple Superphosphate

I. PRODUCTION

Fluorides

Ref (33) p 52 states "... poorly controlled GTSP plants can release up to 0.6 pounds of fluoride per ton of P_2O_5 input."
We will assume this to be Eu since Ref (77) p 107 states that, "..... the blunger and reaction tanks are usually ventilated through a common scrubber ...."
As a result of the industry having partial control,

$$\boxed{E_{U_F} = 0.6\ \#/\text{ton } P_2O_5}$$

Ref (13) p 53 indicates that emissions from a well controlled GTSP plant can be as low as 0.12 #/ton P_2O_5

$$\therefore \boxed{E_{C_F} = 0.12\ \#/\text{ton } P_2O_5}$$

Ref (149) p 1-9 table 1-8

$$\boxed{E_{C_F} = 0.11\ \#/\text{ton } P_2O_5}$$

Particulates

Ref (040) p II-15 states

"All modern plants in the U.S. [granulated or pulverized GTSP] make use of some type of wet scrubber for fluorides and particulate dust. The latter will have been

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Computation Sheet For Emission Factors

Calculations Done By Norman Date 9/6/74

Source Fertilizer - GTSP

Reduced, upstream of the scrubber, to low levels by dry collectors that return solids to the process.

∴ $\boxed{E_{U_p} = 0}$ $\boxed{E_{M_2} = 0}$

In addition, Ref (75) pp 6.10-1,2 makes no mention of particulates from production of GTSP.

II. STORAGE

Ref (33)
p 52
Typical plant
500 TPD P_2O_5

Fluorides

Ref (33) p57 Emissions from poorly controlled GTSP plant =

$$.0007 \le E_{U_1} \le .0015 \frac{\#F}{\text{ton} \cdot \text{hr } P_2O_5}$$

Considering the average flow at 24 hr day

$$\boxed{E_{U_1} = 0.026 \ \#/\text{ton } P_2O_5}$$

Ref (33) p57 states P— emissions from a well-controlled storage facility = .0005 #/ton-hour for a 24 hr day

$$\boxed{E_{M_p} = 0.012} \frac{\#}{\text{ton } P_2O_5}$$

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Computation Sheet For Emission Factors

Calculations Done By Hagopa Date 9/6/74

Source Fertilizers - GTSP

Ref (31) p 62

$E_{u/c} = E_{N} = .012$

$\boxed{E_{u/c_{p}} = 0.012 \frac{lb}{ton\ P_2O_5}}$

Particulate

No emission data could be located regarding particulate emissions from GTSP storage. However Ref (??) p 326, Table 15-1 makes reference to losses during handling of phosphate fertilizers in general. For lack of any specific info, we will use this value. Emissions from storage during quiescent periods is considered to be negligible.

$E_{u/p} = 1 \ {}^{lb}/_{ton\ product}$

@ 46% P_2O_5 (Ref (31) p 50)

$\boxed{E_{u/p} = 2.17 \frac{lb}{ton\ P_2O_5}}$

Ref (75) p 5.10-1 Table 5.10-1 shows
R = 99% with fabric filters

$\boxed{E_{c/p} = 0.022 \frac{lb}{ton\ P_2O_5}}$

Project Number - 32391 New Source Performance Standards

Computation Sheet For Emission Factors

Calculations Done By [illegible] Date 10/16/84

Source Fertilizers - GTSP

Determination of Es

Projections (Source)

Ref (33) "... Projected granular triple superphosphate production is expected to be restricted by [illegible] designed for multipurpose applications. [illegible] facilities designed for DAP manufacture will also produce GTSP to satisfy demand ..."

Assume, therefore, same distribution of plants as for DAP
73% Florida
27% Scattered around U.S.

Ref (108) p.25 shows 16 plants with a capacity of 9.9x10⁶ tons in 1975 (P_2O_5)

$$\frac{(9.9\times10^6)(2000)}{(16)(8760)} = 75,628 \ \frac{\#P_2O_5}{HR} \quad (37.81\ TPH)$$

From Ref (95) p 160.4002A, yield is 63-73% TSP

So, assuming the average 1 #feed → .68 #/TSP @ 46% P_2O_5
↑
Same ref, same page.

$$\frac{\frac{1\ \#\ feed}{0.68\ \#\ TSP}}{\frac{0.46\ \#\ P_2O_5}{\#\ TSP}} = 3.197 \ \frac{\#\ feed}{\#\ P_2O_5}$$

$$\left(75,628\ \frac{\#\ P_2O_5}{HR}\right)\left(3.197\ \frac{\#\ feed}{\#\ P_2O_5}\right) = 241,783\ \frac{\#\ feed}{HR}$$

From Ref (34) p 89 Table [illegible]
E_{DEA} = 39 #/hr

From Chapter's fig curve
E_S = 50 #/hr

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Computation Sheet For Emission Factors

Calculations Done By [illegible] Date 10/16/74

Source Fosforiqua -673P

$$E_3 = (.73)\left(\frac{59}{57.81}\right) + (.27)\left(\frac{76.5}{57.81}\right) = .753 + .357 = 1.11$$

$$\boxed{E_{3\,\substack{\text{PART.}\\\text{[illegible]}}} = 1.11 \ \text{lb}/\text{ton}\ P_2O_5}$$

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Computation Sheet For Emission Factors

Calculations Done By [illegible] Date 10/16/84

Source Fertilizers – GTSP

Fluorides (Production)

Ref (148) Florida has a regulation of 0.15 #/ton P_2O_5
Assume other states to be uncontrolled

$E_S = (.73)(.15) + (.27)(.6) = .1095 + .162 =$

$E_{S_{\text{fluorides production}}} = 0.272$ #/ton P_2O_5

(Storage)

Ref (148) Florida has a regulation of 0.05 #/ton P_2O_5

This value of E_S for Florida
① Is greater than E_U
② Has no base factor associated with it

Therefore, we will assume $E_S = E_U$

$E_{S_{\text{fluorides storage}}} = 0.016 \frac{\#}{\text{ton } P_2O_5}$

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Computation Sheet For Industrial Factors

Calculations Done By Hartman Date 9/3/74

Source NITRATE FERTILIZERS

REF (71) P 6.8-1

WE WILL CONSIDER AMMONIUM NITRATE TO BE MOST REPRESENTATIVE OF THE CATEGORY "NITRATE FERTILIZERS."
REF (73) P 706.5020A OCT 1968
HOWEVER, NOT ALL AMMONIUM NITRATE IS USED FOR FERTILIZER, SOME IS USED FOR EXPLOSIVES & AS A PRECURSOR FOR NITROUS OXIDE.

IN 1967, TOTAL CONSUMPTION WAS 5,495,000 TONS OF WHICH 4,490,000 TONS WERE USED FOR FERTILIZER OR

$$\frac{4.49}{5.495} = 81\%$$

$$\boxed{P_{c_{fertilizer}} = 7\%}$$ (ASSUME (?)) REF (73) P 706.5020A

1967 PROD of AN total = 5.605×10⁶ TONS - OR - 1967 PROD AN fertilizer = (.81)(5.605) ×10⁶

PROD 1975 of AN fertilizer = ( )(1.07)⁸ = 7.808×10⁶ TONS

1975 PROD AN (fertilizer) ≅ 8.089×10⁶ TONS

K IS BETWEEN 75% - 80% REF (73) P 706.5020A OCT '68
ASSUME 77%

$$\boxed{K = 0.77}$$

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Computation Sheet For Industrial Factors

Calculations Done By ______ Date 9/3/74

Source [illegible] Fertilizers

$$A = \frac{8.089\times10^6}{0.77} = 10.505\times10^6$$

$$\boxed{A = 10.505\times10^6\ MW/s}$$

WM 9-25-74

Depreciation of Fertilizer Plants (Obsolescence Rate P_8) may be estimated by IRS Guideline Table.

Ref 077 pg 33 Section 28.0

Asset guideline period 11 yrs
P_8 est = 2×IRS 22 yrs

100% Depreciate in 22 yrs $\frac{100\%}{22\ yr} = 4.5\%/yr$ simple

$$\boxed{\therefore P_8 = .045 \text{ simple}}$$

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Computation Sheet For Emission Factors

Calculations Done By [illegible] Date 9/3/78

Source Nitrate Fertilizers

Ref (95) THE SOURCE [illegible] AS STATED

"1. Prilling. .... Practically all solid products for use in fertilizers ..... are made in this manner."

2. Granulation

Two companies produce AN using rotary granulators
(a) Cominco Am., Nebraska
(b) Chevron Chem., California

Ref (62) states the capacity of these two plants & the capacity of the industry in 1966

(a) 200,000 tons
(b) 59,000 tons Total cap. 1966 = 7.864×10^6 T

$\therefore \frac{259{,}000}{7.864 \times 10^6} = 3.2\%$ using granulators

[illegible] 96.8% using prilling tower

Ref (98), gives the emission factors which we will scale by % utilization

$E_{NH_4NO_3} = (.968)(0.9 + 12) + (.032)(0.4 \times 20)$

$12.487 + .257 = 12.74$ #/ton

$\boxed{E_{part} = 12.72 \text{ \#/ton}}$

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Computation Sheet For Emission Factors

Calculations Done By ______________ Date 9/8/84

Source Nitrate Fertilizers

$E_{c\,NH_3} = .968(2) + (.038)(2 + .5 + .7)$

$= 1.936 + .122 = 2.058$

$E_{NH_3} = 2.058$ #/ton

$E_{U\,NO_3} = (3.3)(.038) = .125$ #/ton $= E_{c\,NO_3}$

This emission is found with granulation process only

Ref 122, p 74

$\eta = 98\%$ for scrubber/filter system on prilling tower operations

$E_{U\,part} = 0.02(12.72) = 0.254$

$E_{c\,part} = 0.254$ #/ton

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Computation Sheet For Emission Factors

Calculations Done By Hogan Date 9/3/74

Source Nitrogen Fertilizers

Ref (40) p XIII-1 $\eta_{NH_3} = 98\%$ with wet scrubber

$$E_{N_{NH_3}} = .02(2.055) = 0.041$$

$$\boxed{E_{N_{NH_3}} = 0.041 \ \#/ton}$$

As we have done with other pollutants whose emissions appear to be low before control, an $E_N = 0$ is assumed to determine the maximum impact ($T_S - T_N$) of NSPS. If the impact is negligible, the assumption will have served its purpose, if, however, the impact is great, a control level would have to be determined.

$$\boxed{E_{N_{NH_3}} = 0}$$

Ref (18) p III-6 gives 1966 plant locations based on E_B [illegible]

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Computation Sheet For Emission Factors

Calculations Done By [illegible] Date 10/17/78

Source Nitrate Fertilizers

E_S

Ref (42) p 14-16 indicates production in 29 states

so we will use the general process weight curve for all states being representative of the industry.

Ref (42) p 14-8 shows a 1966 capacity of 7.864×10^6 tons produced by 59 companies

$$\frac{(7.864\times10^6)}{(59)(8760)} = 15.22 \text{ TPH per plant of AN}$$

$$15.22(2000) = 30{,}431 \ \text{\#/hr of AN}$$

From the gen'l PWR curve

$$E_S = f(30431\times1.025) = f(31192 \ \text{\#/hr}) = 24.9 \ \text{\#/hr}$$

Ref (15) p 366, 368 D
Reading 73
.210 - .229 tons NH3
.800 - .819 tons HNO3
per ton of AN
∴ 1.01 - 1.04/ton AN
AVG = 1.025/1

$$E_{S_p} = \frac{24.9}{15.22} = 1.64 \ \text{\#/ton AN}$$

$$\boxed{E_{S_{part}} = 1.64 \ \text{\#/ton AN}}$$

There are no other regs for ammonia. Assume $E_S = E_U$

$$\boxed{E_{S_{NH_3}} = 2.058 \ \text{\#/ton AN}}$$

NO_x

Indiana, Illinois & Massachusetts have gen'l NO_x regulations Ref (48)

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Computation Sheet For Emission Factors

Calculations Done By [illegible] Date 10/17/78

Source Ammonium Nitrate

Illinois' is 5 #NOx/ton of 100% HNO3 made

Indiana's is a function of ambient air quality

There are no AN plants in the 3rd state, Mass.

From ref ⑨② p. 16

6% of the AN capacity is in Illinois
2% " " " " is in Indiana

Assume 8% of capacity to have a 5 #/ton acid reg

& 92% of capacity, uncontrolled

Ref ⑨③ p 706.5020 D states 0.800 - 0.815 tons HNO3 (100%) per ton of AN
Assume, 0.807

$5 \frac{\# NO_x}{ton\ HNO_3} \times .807 \frac{ton\ HNO_3}{ton\ AN} = 4.035 \frac{\# NO_x}{ton\ AN}$

$E_5 = \left[(0.08)(4.035) + (.92)(3.9)\right] \times (.032) = (.3228 + 3.588)(.032)$

↑ % plants using granulation

$\boxed{E_{NO_x} = 0.125\ \#/ton\ AN}$

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Computation Sheet For Emission Factors

Calculations Done By [illegible] Date 11/1/84

Source Nitrogen Fertilizers

Der'n of E_{ctrl}

Ref ㊵ p. VIII-1 stated a control efficiency of 98% with a wet scrubber. Since this is based on 1970 technology & scrubbers are amenable to retrofit situations, we will assume

$E_{ctrl} = E_{u}$ [illegible]

$E_{ctrl} = 0.041$ #/ton

Ammonia

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Computation Sheet for Industrial Factors

Calculations Done By [illegible] Date 4/23/75

Source [illegible] - [illegible] [illegible]

Ref (95) p 760.5001 A, B states

This is a [illegible] of 4/4/75 calculation sheet

① "... NSP, used exclusively as a fertilizer, has steadily declined over the past twenty years ..."

② "... NSP should thus continue to be phased out ..."

Ref (95) p 760.5001 B

1973 production = 750×10^3 tons P_2O_5

1980 production = 435×10^3 tons P_2O_5 (Avg of [illegible] & 475×10^3)

$$P_c = \sqrt[7]{\frac{435}{750}} - 1 = -7.49\%$$

$$\boxed{P_c = -0.075}$$ compound

Ref (95) p 760.5001A states that the number of plants has decreased from 154 in 1967 to 66 in 1971. We will assume that the majority of these are obsolete (or small) plants which are not being replaced.

$$\boxed{P_B = 0}$$

Assume K to be equal to that for GTSP & ROP-TSP plants. See "Industrial Factors" for these two categories.

$$\boxed{K = 0.7\%}$$

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Computation Sheet For Industrial Factors

Calculations Done By Hamre Date 1/23/75

Source Fertilizers - NSP

$$A = \frac{(790 \times 10^3)(1 - .075)^2}{76} = 0.844 \times 10^6 \text{ tons}$$

$$\boxed{A = 0.844 \times 10^6 \text{ tons } P_2O_5}$$

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Computation Sheet For Emission Factors

Calculations Done By [illegible] Date 4/23/75

Source [illegible] - MSP

Since R is negative & $R_s = 0$, NSPS do not apply to the criteria pollutants; however, the states must regulate designated pollutants under Sec 111d of the Act

Fluorides

Ref (59) p 5-177 gives an emission factor for "average industry operation" of 6.9 #/ton

$$\boxed{E_{U_F} = 6.9 \text{ \#/ton } P_2O_5}$$

Using two stage cyclonic scrubbers with an $R_{max} = 99.23\%$ the controlled emission factor is (same ref/page)

E_N is not applicable because of negative R & zero R_s.

$$\boxed{E_{NSPS} = 0.5 \text{ \#/ton } P_2O_5}$$

This ref gives a fugitive emission factor of 6.9 #/ton.

Assume that the geographic distribution of plants is the same as for the [illegible] on area (see "[illegible]" for these categories)

i.e. 60% - Fla
40% elsewhere

Florida has no specific reg for MSP, however, they state (Ref (48)) that such a source "will comply with best technology." Assuming that best technology is 0.5 #/ton & that emissions are uncontrolled in the other states,

$$E_S = .6(.5) + .4(6.9) = .3 + 2.76 = \boxed{3.1 \text{ \#/ton } P_2O_5 = E_{S_F}}$$

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[illegible]

Project Number - 32391 New Source Performance Standards

Computation Sheet For Industrial Factors

Calculations Done By [illegible] Date [illegible]

Source Fertilizers - Normal Superphosphate

REF (93) [illegible] p 760.3001 A, B

① "NSP, used exclusively as a fertilizer, has steadily declined over the past twenty years .... "

② "... NSP should thus continue to be phased out ..."

It is our judgement in this case that since the production of NSP is being phased out, the following are occurring

Ⓐ No new plants are being built
Ⓑ As plants and equipment [illegible] become obsolete, they are not repaired or replaced since there is no economic incentive to do so.

$\therefore$ P_C is negative
$P_B = 0$

This industry is not a candidate for NSPS

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Project Number - 32391 New Source Performance Standards

Computation Sheet For Industrial Factors

Calculations Done By [illegible] Date 4/23/75

Source Fertilizer - ROP Triple Superphosphate

This is an update of the 9/6/74 calculation sheet

Ref (75) p 760.4001 A states

B. Since 1955, TSP has typically represented 25% to 30% of the total annual domestic P_2O_5 fertilizer supply, and its overall growth trend has tended to parallel that of the total. This pattern will not necessarily continue. Demand for ROP (run-of-pile) grade, used almost exclusively as a phosphate source in "wet" mixed fertilizers produced in regional continuous ammoniation plants, is expected to decline from an estimated 474 thousand short tons P_2O_5 in 1972 to between 250 and 350 thousand short tons P_2O_5 by 1980 (average annual growth rate (-4) - (-7.75%)). This rate of change is predicated on slow attrition in the demand for chemically mixed fertilizers by medium to small farms, particularly in the Southeast. Actually, the precise trend in output and supply of ROP grade will be determined more by management decisions to operate or close continuous ammoniation plants than by true demand (need).

Assume 474,000 tons in 1972
300,000 tons in 1980

$$P_c = \sqrt[8]{\frac{300}{474}} - 1 = -5.6\%$$

$$\boxed{P_c = -5.6\%} \text{ compound}$$

$$\text{1975 Production} = (474{,}000)(1-.056)^3 = 0.399\times10^6 \text{ tons } P_2O_5$$

Assume K to be the same as for granulated TSP

See "Industrial Factors"
"Fertilizers - Granulated TSP" $\boxed{K = 0.76}$

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Computation Sheet For Industrial Factors

Calculations Done By Hunter Date 8/22/75

Source Fertilizers -- RCP Triple Superphosphate

$$A = \frac{0.399 \times 10^6}{0.76} = 0.525$$

$$\boxed{A = 0.525 \times 10^6 \text{ tons } P_2O_5}$$

Ref (37) p.35 AC 28.0 gives the IRS Asset guideline period of 11 years. Assuming twice this value yields a obsolescence rate of

$$\text{Obs. Rate} = \frac{1}{22} = 0.045$$

Since P_C is greater than this, we can assume that no obsolete facilities are being replaced. In fact, now existing plants would be shut down or the productivity decreased.

$$\therefore \boxed{P_B = 0}$$

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Project Number - 32391 New Source Performance Standards

Computation Sheet For Emission Factors

Calculations Done By Hunter Date 4/23/75

Source RGP - TSP

Since P_E is negative & $P_B = 0$, NSPS do not apply to the criteria pollutants; however, the state must regulate designated pollutants under Sec 111(d) of the CAA.

Fluorides

Ref (33) p 43 states

$$\boxed{E_{U_F} = 1 \ \#/\text{ton } P_2O_5}$$

Ref (149) p 1-9 TAB 1-2 gives

$$\boxed{E_{111d} = 0.2 \ \#/\text{ton } P_2O_5}$$

using a two stage system
(1) Venturis and spray - crossflow packed bed scrubber.
Ref (159) p 8-7

E_N is not applicable because of negative P_E & zero P_B.

From Ref (148), Florida has a regulation of .17 #/ton P_2O_5.
From Ref (159) p 8-7, 60% of the industry is located in Florida.
Assume other States to be uncontrolled

$$E_S = (.60)(.17) + (.40)(1.0) = .102 + .4 = .502$$

$$\boxed{E_{S_F} = 0.50 \ \#/\text{ton } P_2O_5}$$

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Computation Sheet For Emission Factors

Calculations Done By [illegible] Date 8/23/75

Source RDP-TSP

NH_3 was listed in the original contract listing as a potential pollutant. We can find no evidence of this type of emission from RDP-TSP process. In fact EPA states

" Only particulates and fluorides are potential pollutants from this process" Ref ㉝ p45

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Obsolete
Calc's

Project Number : 32391 New Source Performance Standards

Computation Sheet For Industrial Factors

Calculations Done By Hoffman Date 9/4/74

Source Phosphorus - NSP Triple Superphosphate

Ref ⑯ p 740 Vol A [illegible]

B. Since 1955, NSP has typically represented 25% to 30% of the total annual domestic P_2O_5 fertilizer supply, and its overall growth trend has tended to parallel that of the total. This pattern will not necessarily continue. Demand for NSP (ordinary/normal) grade, used almost exclusively as a phosphate source in "dry" mixed fertilizers produced in regional continuous ammoniation plants, is expected to decline from an estimated [illegible] thousand short tons P_2O_5 in 1972 to between [illegible] thousand short tons P_2O_5 in 1985 (average annual growth rate [illegible]). This rate of change is predicated on wide attrition in the demand for chemically mixed fertilizers on medium to small farms, particularly in the Southeast. Actually, the precise trend in output and supply of NSP grade will be determined more by management decisions to operate or close continuous ammoniation plants than by true demand trends.

Since production of NSP-TSP is being phased out, it is highly unlikely that additional plants / equipment would be constructed, due to the lack of economic incentive, we will assume that

$\boxed{P = 0}$

∴ The NSP-TSP industry does not appear to be a likely candidate for NSPS

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Computation Sheet For Industrial Factors

Calculations Done By [illegible] Date 4/28/75

Source Fertilizers - Superphosphoric Acid (Submerged Combustion)

Ref (95) p 760.1101 G [illegible]

1973 Production of SPA = .530×10⁶ tons P_2O_5

Ref (119) p 3-4 states that 79% of the industry uses vacuum evaporation process

$$1973 \text{ Prod. by Sub. Comb.} = (1 - .79)(.530 \times 10^6 \text{ tons}) = 0.111 \times 10^6 \text{ tons}$$

From Ref (93) p 38

"..... its cost [fuel] may render the submerged combustion process economically unattractive for future construction."

Ref (93) p 32

"..... the majority of members of the phosphate fertilizer industry consider submerged combustion an outdated process and future growth unlikely."

We will assume, therefore that

$$\boxed{P_G = 0.0}$$

Ref (119) p 3-9, Table 3-4 indicates that there are only two sub. comb. process plants in existence. One was built in 1967 & the other in 1965.

This same Ref, page 3-?? indicates average plant life to be 15-20 years. Using this value, we can assume that there will be no replacement of facilities before 1985.

Therefore,

$$\boxed{P_R = 0.0}$$

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Computation Sheet For Industrial Factors

Calculations Done By [illegible] Date [illegible]

Source [illegible] - SPA (Submerged Combustion)

Assuming the K for submerged combustion is equal to that for vacuum evaporation (Ref ㊺ p [illegible] "Capacity utilization rate between 70-72%)

Assumed the avg

$$\boxed{K = 0.71}$$

$$A = 0.111\times10^6 / 0.71 = 0.156\times10^6$$

$$\boxed{A = 0.156\times10^6 \frac{\text{tons}}{P_2O_5}}$$

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Computation Sheet For Emission Factors

Calculations Done By [illegible] Date 4/09/75

Source Phosphoric acid (Sup. (cont.)

Since R & B are zero, we are concerned only with emissions of designated pollutants

Fluorides

Ref (159) p 8-7

Avg uncontrolled fluoride emissions between 15 & 20 pounds of fluoride per ton of P_2O_5. Assuming the avg

$E_{U_F} = \approx 17.5$ lb/ton P_2O_5

Ref (159) p 8-8

$E_{ind} = 0.01$ lb/ton P_2O_5

E_s is not applicable due to R & B being equal to zero

Ref (159) p 3-8 The two plants are located in La. & Ala.

La = 127,000 tons P_2O_5
Ala = 69,000 " " $\frac{69}{196} = 35\%$
196,000

La has no emission standard E_s. Ala has no specific regs; however, they state (Ref (163)) that such a source 'will comply with best technology'. Assume that best technology is 0.01 lb/ton

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Computation Sheet For Emission Factors

Calculations Done By [illegible] Date 4/30/75

Source Phosphoric - SPA (Sup. Conc.)

Ew is a totally uncontrolled plant. Existing plants do have some control however.

From Ref (159) p 8-4 .01 is a 90% reduction of fluorine now being emitted

$\frac{.01}{.1} = 0.1$

So $E_{HF} = (.35)(.01) + (.45)(.1) = .0035 + .045 = .0485$

$$\boxed{E_{HF} = 0.049 \ lb/ton \ P_2O_5}$$

Acid Mist

Ref (40) p VII-7 Tab VII-1 gives acid mist emission factor (controlled) of 10 mg P_2O_5/m³ gas. This is 1/5 the value for controlled fluorine emissions

$$E_{mist} = \frac{0.01}{5} = 0.002 \ \frac{lb \ Acid \ mist \ (as \ P_2O_5)}{ton \ P_2O_5}$$

Ref (41) p II-23 indicates control of acid mist using venturi with phosphoric acid as the scrubbing medium.

Ref (40) p IV-8 indicates a typical η between 99.2% & 99.6%

Using the avg of 99.4%

$\frac{Eu - .002}{Eu} = .994$ $$\boxed{Eu = 0.33 \ \frac{lb \ P_2O_5}{ton \ P_2O_5}}$$

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Project Number - 32391 New Source Performance Standards

Computation Sheet for Emission Factors

Calculations Done By [illegible] Date 9/30/75

Source [illegible] - 3019 ([illegible] Canada)

Since there were no [illegible] for acid-mist,

$$E_{SO_3} = EU = 0.11$$

$$\boxed{E_{SO_3} = 0.11 \ \text{lb} \ SO_3/\text{ton}}$$

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Computation Sheet for Industrial Factors

Calculations Done By Hopper Date 10/17/79

Source Fertilizers - Superphosphoric Acid (Wet Evap)

Ref (95) p 760.2503 B Dec '78

1978 Production = 530,000 tons P_2O_5

Ref (96) p 760.2503 A Capacity utilization rate between 70 - 72%

Assume the avg

$$\boxed{K = 0.71}$$

Ref (95) p 760.2501 A

Growth rate between 7.25% & 9.75% (projection)
If we assume the average to be correct

$$\boxed{P_c = 0.085}$$ cap

$$A = \frac{(530 \times 10^3)(1+.085)^2}{0.71} = 0.879 \times 10^6 \text{ tons}$$

$$\boxed{A = 0.879 \times 10^6 \text{ tons } P_2O_5}$$

From Ref (37) p 33 section 28.0 the depreciation guideline for fertilizer plants is 11 years. Assume 2x this guideline for P_d

$$P_d = \frac{100\%}{22 \text{ yrs}} = 4.5\%$$ $$\boxed{P_d = 0.045}$$ simple

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Computation Sheet For Industrial Factors

Calculations Done By [illegible] Date 10/31/74

Source Fertilizer - SPA (Vac. Evap)

We are concerned with the vacuum evaporation process only ∴ 'A' must be changed

Ref ⑮⑨ p 2-4 states

79% of the SPA industry uses vac. evap & no additional control (by the States) will be required.

$$A = (0.879\times10^6)(.79) = 0.694\times10^6$$

$$\boxed{A_{\substack{vac\\evap}} = 0.694\times10^6 \ \tfrac{tons}{yr}}$$

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Computation Sheet for Emission Factors

Calculations Done By [illegible] Date 10/17/79

Source Fertilizer - Superphosphoric Acid (Vac. Evap)

Superphosphoric acid, a concentrated form of phosphoric acid, is manufactured by two processes:

1) Vacuum evaporation
2) Submerged combustion

For the submerged combustion process, Ref (33) p 28

"... its cost [(fuel)] may render the submerged combustion process economically unattractive for future construction."

Ref (33) p 32

"... the majority of members of the phosphate fertilizer industry consider submerged combustion an outdated process and future growth unlikely."

We will assume that all growth will employ the vacuum evaporation method. Emission factors will be set to reflect this process.

Ref (73) p 86

$$E_{F_{[illegible]}} = \frac{0.016(24)}{300} = 0.005 \text{ \#/ton } P_2O_5$$

$$\boxed{E_{F} = 0.005 \text{ \#/ton } P_2O_5}$$

Ref (73) p 86

$$E_{PM} = f(\text{[illegible]}) = \frac{0.011(24)}{360} = .00088$$

$$\boxed{E_{PM} = 0.00088 \text{ \#/ton } P_2O_5}$$

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Computation Sheet For Emission Factors

Calculations Done By Hughes Date 10/13/84

Source Phosphates - SPA (Sub. Comb.)

Acid mist emissions are associated only with the submerged combustion process.

Der'n of E_S

There are no specific state regulations controlling emissions from SPA plants.
Assume, therefore $E_S = E_N$

$$\boxed{E_{S_N} = 0.005\ \#/\text{ton}\ P_2O_5}$$

Der'n of $E_{111(d)}$

Ref ⑲ p 8-4 states that no additional control by the states is req'd
Assume ∴ $E_{111d} = E_N$

$$\boxed{E_{111d} = 0.0088\ \#/\text{ton}\ P_2O_5}$$

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Project Number - 32391 New Source Performance Standards

Computation Sheet For Industrial Factors

Calculations Done By K. Tower Date 1/28/75

Source Pesticides

The production of pesticidal chemicals are listed in ref 269, p. 108 for the years 1964-1967 as the following:

Year	Production (Thousands of pounds)
1964	805,206
1965	872,159
1966	1000,688
1967	1017,218
1970	1239,000 (Ref 0957 - Summary of total prod. tables)

Assuming a compound growth rate P is calculated as follows:

$$P_c = \sqrt[1970-1964]{\frac{\text{Prod in 1970}}{\text{Prod in 1964}}} - 1.0 = \sqrt[6]{\frac{1,239,000}{805,206}} - 1.0 = \sqrt[6]{1.539} - 1.0$$

$$= 1.074 - 1.0 = .074$$

$$\boxed{\underset{\text{Compound}}{P_c} = .074}$$

From ref 144, p 48, Table I we obtain the practical utilization rate of chemical manufacturers for the period Dec 1965 - Dec 1973, which is 83%. No specific K could be found.

$$\boxed{K = .83}$$

$$A = \frac{(1,239,000,000\ \text{lbs})(1.074)^5}{(.83)(2000\ \frac{\text{lbs}}{\text{TON}})} = 1.067 \times 10^6\ \frac{\text{TONS}}{\text{YR}}$$

$$\boxed{A = 1.067 \times 10^6\ \frac{\text{TONS}}{\text{YR}}}$$

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Computation Sheet For Industrial Factors

Calculations Done By K. Towey Date 1/30/75

Source Pesticides

From Ref 37, p. 33, the allowable IRS guideline for manufacture of chemicals and allied products... " is 11 years. Assuming twice the allowable

$$P_n = \frac{1}{2(11)} = 0.045$$

$$\boxed{P_n = 0.045 \text{ simple}}$$

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Project Number - 32391 New Source Performance Standards

Computation Sheet For Emission Factors

Calculations Done By K. Tower Date 1/28/78

Source Pesticides

The pesticide industry does not produce one specific hazardous chemical but rather many that are potentially hazardous. In addition this industry is constantly changing by the introduction of new pesticides, modification of present pesticides, and the reduction in production of obsolete pesticides. We make the assumption that all product emissions from the pesticide industry are hazardous chemicals.

From ref 269, p 39 we find that "pesticides are generally manufactured in closed systems of a continuous - process nature. The process systems are normally maintained at a slightly negative pressure to avoid leakage." No information regarding emissions of pesticides were found but from the previous reference we make the assumption that 0.5% of pesticide production is emitted to the atmosphere.

$$E_u = \frac{\left(.005 \times 1.067 \times 10^6 \frac{\text{TONS}}{\text{YR}}\right)\left(2000 \frac{\text{lbs}}{\text{TON}}\right)}{1.067 \times 10^6 \frac{\text{TONS}}{\text{YR}}} \cong 10 \text{ lbs}/\text{TON}$$

$$\boxed{E_u = 10 \text{ lbs}/\text{TON}}$$

We make the assumption that the majority of these uncontrolled emissions are in the form of particulates. We further assume that a baghouse filter will be able to control emissions by 99%. E_N will then equal $10 \times .01 = .1$ lbs/TON

$$\boxed{E_N = 0.1 \frac{\text{lbs hazardous chemicals}}{\text{TON}}}$$

Project Number - 32391 New Source Performance Standards

Computation Sheet For Emission Factors

Calculations Done By K. Tower Date 1/30/75

Source Pesticides

We also assume that efficiency from a baghouse filter will be the same for both an existing plant and a new plant. $E_{111d} = E_N$

$$\boxed{E_{111d} = 0.1 \frac{\text{lbs}}{\text{ton}} \text{ hazardous chemicals}}$$

There are no general state hazardous chemicals regulations. If one assumes state particulate regulations for the control of pesticide emissions the following emission factor can be derived:

Ref 269, p 118 states there are 340 pesticide plants.

$$\text{Process Weight Rate} = \frac{\left(1.067 \times 10^6 \frac{\text{TONS}}{\text{YR}}\right)\left(2000 \text{ lbs}/\text{ton}\right)}{\left(260 \frac{\text{DAYS}}{\text{YR}}\right)\left(8 \text{ HRS}/\text{day}\right)\left(340 \text{ plants}\right)} = 3.02 \times 10^3 \text{ lbs}/\text{hr}/\text{PLANT}$$

From the general process weight curve, ref [illegible] + ref 148, we obtain a 5.5 lb/hr/PLANT allowable emissions.

$$\text{TONS}/\text{HR}/\text{Plant} = \frac{\left(1.067 \times 10^6 \frac{\text{TONS}}{\text{YR}}\right)}{\left(260 \frac{\text{DAYS}}{\text{YR}}\right)\left(8 \text{ hrs}/\text{day}\right)\left(340 \text{ Plants}\right)} = 1.51$$

$$E_S = \frac{5.5 \text{ lbs}/\text{hr}}{1.51 \frac{\text{TONS}}{\text{hr}}} = 3.64 \text{ lbs}/\text{TONS}$$

$$\boxed{E_S = 3.64 \text{ lbs}/\text{TON}}$$

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Project Number 32391 New Source Performance Standards

Computation Sheet For Industrial Factors

Calculations Done By W. Morrens Date 8-1-74

Source Animal Feed Defluorination

K : Ref 040 pg VIII-2 Table VIII-1

Figures given for defluorinated rock industry

1970	Production	180,000 T/yr	as P_2O_5
1970	Capacity	200,000 T/yr	as P_2O_5
1980	Production	180,000 T/yr	as P_2O_5
1980	Capacity	200,000 T/yr	as P_2O_5

$$K_{70} = \frac{180,000}{200,000} = .9$$

$$K_{80} = \frac{180,000}{200,000} = .9$$

$\Rightarrow \boxed{K = .9}$

A : Capacity for 1970 = 200,000 T/yr as P_2O_5
Capacity for 1980 = 200,000 T/yr as P_2O_5

$\boxed{A = 200,000 \text{ T/yr as } P_2O_5}$

P_c : The above reference indicates that the current number of plants is 14 and through to 1980 no additional plants or capacity is expected to be added. We will assume that this is valid up to 1985.

$\boxed{P_c = 0}$

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Project Number : 32301 New Source Performance Standards

Computation Sheet For Industrial Factors

Calculations Done By D. Marrone Date 10-17-74

Source Mineral Feed Defluorination

P_B :

We refer to Ref. 037 to seek some estimate of the obsolescence rate (P_B)

The defluorination of phosphate rock is in truth a mineral preparation operation however it is a sector of the animal feed industry. We have compromised by using these categories in combination to estimate P_B

Section 10.0 pg 30 Asset Period 10 yr
Mining P_B = 2×AP = 20 yrs

$\frac{100\%}{20\ yr}$ = 5%/yr simple

Section 20.1 pg 31 Asset Period = 17 yrs
P_B = 2×AP = 34 yrs

$\frac{100\%}{34\ y}$ = 3%/yr simple

We use the average of 4%/yr ∴

$\therefore P_B = .04$ simple

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Project Number : 32391 New Source Performance Standards

Computation Sheet for Emission Factors

Calculations Done By [illegible] Date 9-17-74

Source Animal Feed Defluorination

Fluorides

Eu: Ref 095 pg 760, 2010 H

≈ 73% of phosphate rock supply since 1950 has been coming from Florida

Ref 095 pg 761, 5020 D Fla Rock 33.9 - 34.4% P_2O_5
Avg = 34.2% P_2O_5

P_2O_5 content of rock in other areas is derived from data in Ref 095 pg 760, 2010 H 1966 Rock Figures

Tenn 3.0 Tons .8 Ton/P_2O_5 → 26.7% P_2O_5

Western 5.2 " 1.5 Ton/P_2O_5 → 28.8% P_2O_5

Avg = 27.8% P_2O_5

We estimate the "weighted average" P_2O_5 content of phosphate rock as:

$$\% P_2O_5 = .73(34.2) + .27(27.8)$$
$$= 24.97 + 7.5$$

$\% P_2O_5$ = 32.5% for average rock P_2O_5 content

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Computation Sheet For Emission Factors

Calculations Done By AJ Marrone Date 9-17-74

Source Animal Feed Defluorination

Fluorides cont'd

E_u

Rock defluorination occurs simply by the following reaction;

$$\overset{1008\ MW}{CaF_2 \cdot 3Ca_3(PO_4)_2} + H_2O + SiO_2 \rightarrow \overset{930\ MW}{3Ca_3(PO_4)_2} + CaSiO_3 + 2HF$$

Since the molecular weight change is not significant we make the assumption that the P_2O_5 content of rock feed and the defluorinated product is the same. Therefore = 32.5% P_2O_5 content

From Ref 050 "Animal Feed Defluorination" pg 1

Rock of 3.5 to 4% F content can be thermally treated to reduce the fluorine content to less than .2% in which case it is suitable for use in animal feed supplements.

Now,

1 Ton Rock contains 32.5% P_2O_5
3.75% F

1 Ton Product contains 32.5% P_2O_5
.2% F

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Project Number 32391 New Source Performance Standards

Computation Sheet for Emission Factors

Calculations Done by [illegible] Date [illegible]

Source [illegible] Rock [illegible]

Fluorides emitted

F_u Feed Rock (ton) [illegible]

650 lb P_2O_5 650 lb P_2O_5

75 lb F 4 lb F

The Quantity potentially emitted to atmosphere is approximated by the difference in mass from input to output per ton of P_2O_5.

[illegible]

[illegible] 12.3 [illegible]

Potentially [illegible] = [illegible] = 219 lb/ton

F_u = 219 lb / ton P_2O_5

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[illegible] 32[illegible] New Source Performance Standards

[illegible] Emission Factors

[illegible] [illegible] Date: 9-17-79

[illegible] [illegible] Rock [illegible]

[illegible]

Ref [illegible] (56) "[illegible] Rock [illegible]" pg 2-3

[illegible] [illegible] % [illegible]

E_U = .03 × [illegible] = .419 lb/ton P_2O_5

[illegible]

E_H = .[illegible] lb/ton P_2O_5 [illegible]

[illegible]

$E_S = (\ [illegible]\ ) + (\ [illegible]\ ) = 59.[illegible]$ lb/ton P_2O_5

E_S = 59.[illegible] lb/ton P_2O_5 [illegible]

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Project Number - 32391 New Source Performance Standards

Computation Sheet for Emission Factors

Calculations Done By W. [illegible] Date 1-29-75

Source Animal Feed Defluorination

Particulates:

E_u: We were not able to obtain emission factors, emission data or any estimates for particulate emissions from this source. We make the judgment that animal feed defluorination plants being thermal treating and rock handling processes may be compared at this point with lime plants until more definitive data become available.

$$E_u(\text{lime}) = 203 \text{ lb/ton lime product}$$

$$E_u(P_2O_5) = 203 \frac{\text{lb}}{\text{ton product}} \times \frac{\text{ton prod}}{.325 \text{ ton } P_2O_5} = 625 \text{ lb/ton } P_2O_5$$

This includes kiln emissions, material handling operations, and rock classifying operations.

$$\boxed{E_u = 625 \text{ lb/ton } P_2O_5}$$

E_N: An efficiency for particulates at 99.99% with baghouses
$E_N = .0001 \times E_u$

$$\boxed{E_N = .0625 \text{ lb/ton } P_2O_5}$$

Project Number - 32391 New Source Performance Standards

Computation Sheet For Emission Factors

Calculations Done By W. Marrone Date 1-29-75

Source Animal Feed Defluorination

Particulate: cont'd

E_s:

Using, $P = .2 \times 10^6$ ton/yr P_2O_5
Plants = 4
32.5% P_2O_5 8760 hr/yr

we may estimate the avg process weight rate for a plant

$$\text{Avg Plant} = \frac{.2 \times 10^6 \text{ ton } P_2O_5/\text{yr}}{.325 \, P_2O_5/\text{ton prod} \times 4} \times \frac{1\text{yr}}{8760\,\text{hr}} \times \frac{2000\,\text{lb}}{\text{ton}}$$

$$\text{Avg Plant} = 35{,}125 \ \text{lb/hr}^{\text{process wt}}$$

With the states of Florida, Texas, and Montana and assuming 73% from Fla and 13.5% from each of Texas and Montana we may develop a "weighted" E_s from allowable emissions by state process weight rate curves. Ref. 084-148

Florida = 21 lb/hr
Texas = 52 lb/hr
Montana 28 lb/hr

$$\text{weighted lb/hr} = .73(21) + .135(52) + .135(28)$$
$$= 15.33 + 7.02 + 3.78$$
$$\text{weighted lb/hr} \approx 26.1 \ \text{lb/hr}$$

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Computation Sheet For Industrial Factors

Calculations Done By W. Marrone Date 1-29-75

Source Animal Feed Defluorination

Particulates cont'd

E_b:

$$\text{Avg Plant } \frac{\text{ton } P_2O_5}{\text{hr}} = \frac{.2 \times 10^6 \text{ ton } P_2O_5/\text{yr}}{4} \times \frac{\text{yr}}{8760 \text{ hr}} = 5.71 \frac{\text{ton}}{\text{hr}}$$

$$\boxed{E_b = \frac{26.1 \text{ lb/hr}}{5.71 \frac{\text{ton } P_2O_5}{\text{hr}}} = 4.57 \text{ lb/ton } P_2O_5}$$

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Project Number - 32391 New Source Performance Standards

Computation Sheet For Industrial Factors

Calculations Done By D. Marrone Date 9-19-74

Source Beer Processing

P_c : Ref 012 pg 8-2

"Malt liquor production should increase by 7 percent per year through 1980,"

We assume this growth rate (compound) to be applicable for the period 1975-1985

$P_c = .07$ compound

K : Ref 144 July 1974 pg 148 Table 1

The table gives a summary of capacity utilization rates for various manufacturing sectors. We will use the average value (Qtr 1967 to Qtr 1973) of K = .81 which is identified as representing the Food (including beverage) industry.

$K = .81$

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Computation Sheet For Industrial Factors

Calculations Done By D. Marrone Date 9-19-74

Source Beer Processing

A :

Ref: 012 pg 1-3

1970 Production 134.7×10^6 barrels

From pg 8-2 there are 31 gal/barrel, therefore we calculate

$$P_{70} = 134.7 \times 10^6 \frac{\text{barrels}}{\text{yr}} \times 31 \frac{\text{Gal}}{\text{barrel}} = 4.175 \times 10^9 \text{ Gal/yr}$$

Using the value of $P_G = .07$ we may estimate the 1975 production level

$$P_{75} = P_{70} (1 + P_G)^5$$

$$P_{75} = 4.175 \times 10^9 \ (1.07)^5$$

$$\left(\text{see attached graph}\right) \longrightarrow \quad P_{75} = 5.85 \times 10^9 \text{ Gal/yr}$$

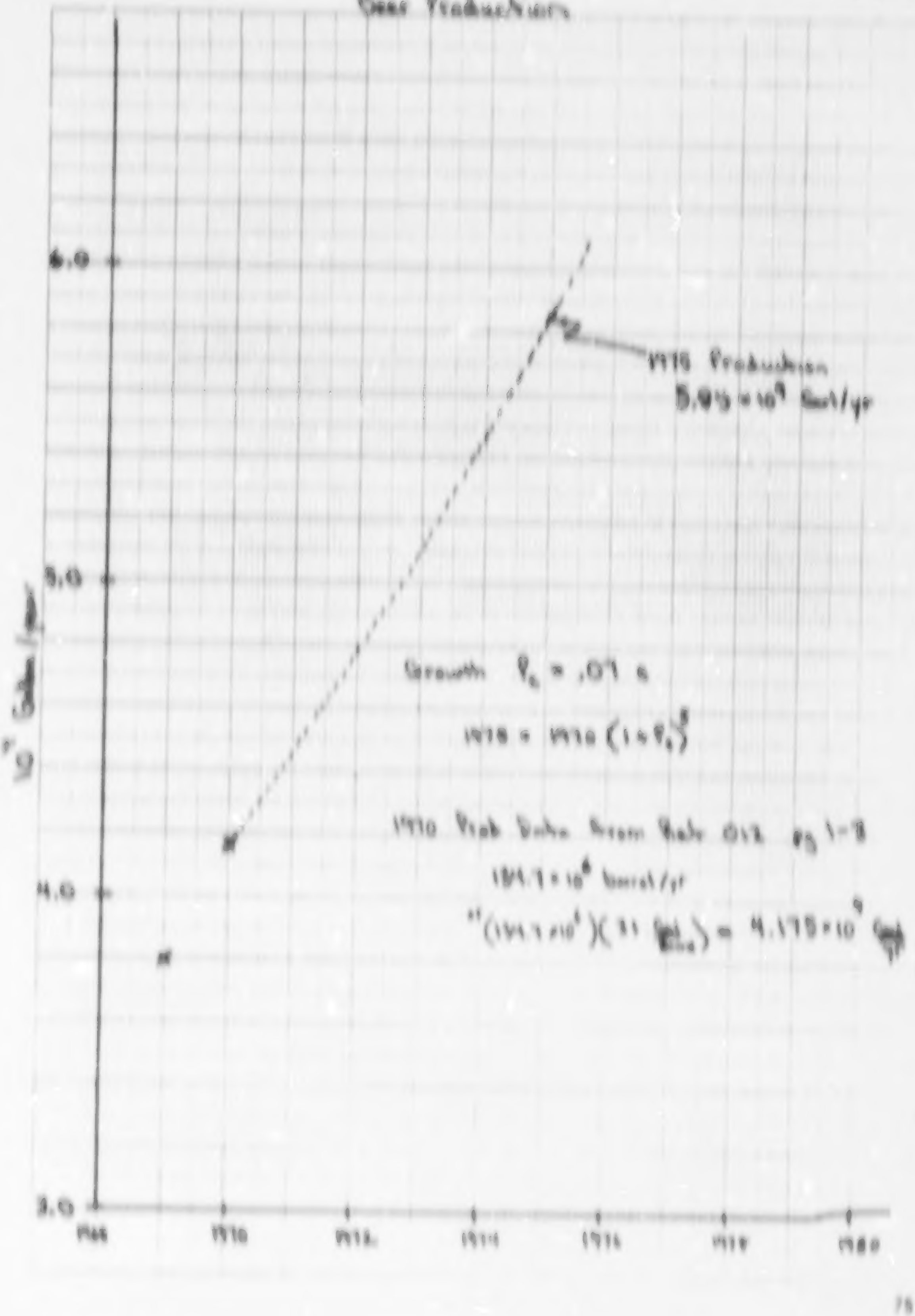
With $K_1 = .81$,

$$A = \frac{P_{75}}{K_1} = \frac{5.85 \times 10^9}{.81} = 7.2 \times 10^9 \frac{\text{Gal}}{\text{yr}}$$

$$\therefore \ A = 7.2 \times 10^9 \text{ Gal/yr}$$

$$\text{or } A = 7.2 \times 10^6 \ \underline{\text{Thou}} \ \frac{\text{Gal}}{\text{yr}}$$

Beer Production



1975 Production
5.85×10^9 Gal/yr

Growth $r_g = .07$

$1975 = 1970 (1+r_g)^5$

1970 Prod Data from Beer Ind pg 1-8
134.7×10^6 barrel/yr
$(134.7 \times 10^6)(31 \frac{Gal}{Bbl}) = 4.175 \times 10^9 \frac{Gal}{yr}$

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roject Number - 32391 New Source Performance Standards

Computation Sheet For Industrial Factors

Calculations Done By W. [illegible] Date 9-19-79

Source Beer Processing

P_B :

Rev'n 037 pg 31 Section 20.4

Asset guideline period = 12 yrs

P_B est = 2×ADR = 24 yrs

$\frac{100\%}{24 \text{ yrs}} = 4\%/\text{yr}$ simple

$P_B = .04$ simple

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Computation Sheet for Emission Factors

Calculations Done By [illegible] Date 9-19-74

Source Beer Processing

Ref 012 pg 1-3

In 1970 there were 5.69×10^9 lb grain used in breweries.

As mentioned in 'Industrial Factors' the 1970 production was 4.175×10^9 Gal.

We may estimate the grain input requirements per gal of beer produced

$$F = \frac{5.69 \times 10^9 \text{ lb grain}}{4.175 \times 10^9 \text{ Gal}}$$

$$F = 1.363 \text{ lb grain/Gal}$$

Ref 078 Table 6.5-1 pg 6.5-2

Particulates

$$\left.\begin{array}{ll} \text{Grain handling} & 3 \text{ lb/ton grain} \\ \text{Drying spent grain} & 5 \text{ lb/ton} \end{array}\right\} \text{Emissions}$$

Note: Ref 012 p 3-4 also reports the value of 5 lb/ton for drying spent grains but is unclear which the text is referring to. We assume it refers to the [illegible]

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Computation Sheet for Emission Factors

Calculations Done By D Marrone Date 9-19-74

Source Beer Processing

Particulates

Based on the assumption that the emission factors are in terms of Tons of total grain handled (input) we have

$$E = 3 + 5 = 8 \ \frac{\text{lb P}}{\text{Tons Grain}}$$

This factor is converted to lb P/10^3 Gal by utilizing the previously calculated R.

$$E = \frac{8 \text{ lb P}}{\text{Tons Grain}} \times \frac{\text{Tons Grain}}{2000 \text{ lb Grain}} \times \frac{1.362 \text{ lb Grain}}{\text{Gal produced}}$$

$$E = .00545 \ \frac{\text{lb P}}{\text{Gal produced}} \quad \text{or} \quad 5.45 \ \frac{\text{lb P}}{10^3 \text{ Gal}}$$

$$\boxed{E_{14} = 5.45 \ \frac{\text{lb}}{10^3 \text{ Gal beer produced}}}$$

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Project Number - 3391 New Source Performance Standards

Computation Sheet for: Emission Factors

Calculations Done by A. Mancuso Date 9-19-74

Source Beer Processing

Particulates cont'd

Grain driers are normally equipped with cyclone separators which are reported to be about 90% eff.
Ref's (1) pg 9-4 and 14-2.

Baghouses or cyclone separators are normally employed in all grain handling operations. Table 1 pg [illegible] of [illegible] shows eff for cyclones [illegible] at about 90%.

We have assumed that the above control as representative of this industry and as such E_u represents emission from a suitably controlled industry.

E_N:

Cyclone separator and baghouses have been identified as applicable control systems for the beer industry [illegible] We assume that further control may be achieved by their employment. Estimated eff 95%.

$$E_N = .05 \times E_u = .05 \times 5.48 \text{ lb}/10^3 \text{ Gal}$$

$$\boxed{E_N = .27 \text{ lb}/10^3 \text{ Gal beer produced}}$$

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Project Number : 32391 New Source Performance Standards

Computation Sheet For Emission Factors

Calculations Done By W. Mannarino Date 10-31-74

Source Beer Processing

E_3 : Particulate

Ref: 197 , we find that the number of plants in the malt beverage industry in 1967 was 185. Using the 1975 Prod Cap and the Growth rate (r_0 = .07 a) we may estimate the 1967 Prod Cap. This result along with the number of plants is an approximation to the typical plant capacity for beer processing

$$P_{75} = 7.2 \times 10^9 \left(\frac{gal}{yr}\right)$$

$$Cap_{67} = \frac{7.2 \times 10^9}{(1+.07)^8} = 4.19 \times 10^9 \text{ Gal/yr}$$

$$\text{Typical plant} = \frac{4.19 \times 10^9 \text{ Gal/yr}}{185} = 22.65 \times 10^6 \text{ Gal/yr}$$

Using a plant schedule of $365 \frac{d}{yr} \cdot 16 \frac{hr}{d} = 5840 \frac{hr}{yr}$

$$\text{Typical Plant} = 3.88 \times 10^3 \text{ Gal/hr beer}$$

Using the F-factor determined above;

$$1.368 \text{ lb grain / Gal}_{beer}$$

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Project Number : 32391 New Source Performance Standards

Computation Sheet for: Emission Factors

Calculations Done by: D. Massone Date: 10-31-74

Source: Beer Processing

E_5: Particulate cont'd

$$\text{Typical Plant} = 1.363\ \frac{\text{lb grain}}{\text{Gal}} \times 3.88 \times 10^3\ \frac{\text{Gal}}{\text{hr}}$$

$$\underset{\substack{\text{Grain Processing}\\ \text{Weight}}}{\text{Typical Plant}} = 5.29 \times 10^3\ \text{lb/hr grain}$$

The allowable emissions for this process weight rate is obtained from the "50 state arithmetic average".

$$\text{Allowable Emission} = 8.1\ \text{lb}^{\text{Pt}}/\text{hr}$$

$$\boxed{E_5 = \frac{8.1\ \frac{\text{lb Part}}{\text{hr}}}{3.88\ \frac{10^3\ \text{Gal beer}}{\text{hr}}} = 2.09\ \frac{\text{lb Pt}}{10^3\ \text{Gal Beer}}}$$

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Project Number - 32391 New Source Performance Standards

Computation Sheet for Emission Factors

Calculations Done By D. Marrone Date 9-19-74

Source Beer Processing

Hydrocarbons:

Ref 075 Table 6.5-1

No quantitative data given; however HC emissions are reported to be emitted from the drying of spent grains.

Ref 012 pg 3-8

identifies ethyl alcohol as the "possible" major portion of the exhaust streams emitted from the drying of spent grains. No emission data were presented.

1-29-75

In light of the lack of any data with respect to hydrocarbon emissions from drying spent grains we must make some assumptions.

We will assume that the grains have lost 20% of their weight in the beer process, and that hydrocarbon content of the spent grain is 1% by weight.

1 lb spent grains ⟶ .01 lb hydrocarbons

and $\frac{1 \text{ lb}}{.8}$ = 1.25 lb grain therefore $\frac{.01 \text{ lb HC}}{1.25 \text{ lb grain}}$

Project Number - 32391 New Source Performance Standards

Computation Sheet for Emission Factors

Calculations Done By W. Marrone Date 8-29-75

Source Beer Processing

Hydrocarbons cont'd

E_u: using the factor F = 1.363 lb grain/Gal beer

$$E = \frac{.01 \text{ lb HC}}{1.25 \text{ lb grain}} \times 1.363 \frac{\text{lb grain}}{\text{Gal beer}}$$

$$E = .0109 \text{ lb HC}/\text{Gal beer}$$

or

$$\boxed{E_u = 10.9 \text{ lb}/10^3 \text{ Gal beer}}$$

E_c: Since the emissions have been identified as ethyl alcohol & it is suspected that this emission due to its high heat content could be adequately eliminated by incineration. Eff. of 99% is assumed.

$$E_c = .01 \times 10.9 \text{ lb}/10^3 \text{ gal}$$

$$\boxed{E_c = .109 \text{ lb}/10^3 \text{ gal beer}}$$

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Project Number: 32301 New Source Performance Standards

Calculation Sheet for: Industrial Factors

Calculations Done By: [illegible]

Source: Beer Processing

Hydrocarbons cont'd

Ref. [illegible]

There are no regulations specifically applicable to hydrocarbon emissions from beer plants so that we assign $E_5 = E_{10}$

$$E_5 = 10.9 \text{ lb}/10^3 \text{ bbl beer}$$

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[illegible] New Source Performance Standards

[illegible] Industrial Boilers

[illegible] [illegible] 9-10-7[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

NOT NSPS

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Project Number - 32391 New Source Performance Standards

Computation Sheet For Industrial Factors

Calculations Done By W. Mazzone Date 9-16-79

Source Coffee Roasting

K: Ref 006 pg 39

Capacity utilization range for the industry is 80 to 90 percent.

We will use the average as an approximation of K

$$\boxed{K = .85}$$

P_c: Ref 006 pg 39

"No significant change in production or capacity is expected in the current decade. The 1980 green coffee estimate is 19.9 million bags."

pg 38 indicated that the 1978 production was about 20 million bags.

We conclude that $P_c \approx 0$

$$\boxed{P_c = 0}$$

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Computation Sheet For Industrial Factors

Calculations Done By W. Marrone Date 9-16-74

Source Coffee Roasting

P_B: Ref 037 pg 31 Section 20.4

Asset depreciation range life 12 yrs
P_B est = 2×ADR = 24 yrs
100% Depreciation in 24 yrs $\frac{100\%}{24\ yrs} = 4.1\ \%/yr$ simple

we approximate P_B by using 4% simple depreciation rate

$$\therefore P_B = .04 \text{ simple}$$

A: We will use the 1980 est of 19.9 million bags as the production est for 1975

$$P_{75} = 19.9 \times 10^6 \text{ bags/yr}$$

Ref 006 pg 8 1 bag = 132.276 lbs

$$P_{75} = 19.9 \times 10^6 \frac{\text{bag}}{\text{yr}} \times 132.276 \frac{\text{lb}}{\text{bag}} \times \frac{\text{Ton}}{2000\ \text{lb}}$$

$$P_{75} = 1.32 \times 10^6 \text{ Ton/yr}$$

Applying K = .85 we calculate the 1975 Prod Capacity

$$A = \frac{1.32 \times 10^6}{.85} = 1.55 \times 10^6 \text{ Ton/yr}$$

$$\therefore \boxed{A = 1.55 \times 10^6 \text{ Ton/yr}}$$ green coffee beans

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Computation Sheet For Emission Factors

Calculations Done By 2J Monroe Date 9-16-74

Source Coffee Roasting

The majority of emissions come from the roasting and subsequent cooling of the coffee beans

Particulates

E_u: Ref 075 pg 6.2-1

Avg Roaster emission factor $\frac{7.6 + 4.2}{2} = 5.9$ lb/ton

Stoner & cooler 1.4 lb/ton

E = 5.9 + 1.4 = 7.3 lb/ton green coffee beans

$$\boxed{E_u = 7.3 \text{ lb/ton}}$$

E_M: Ref 006 indicates thermal afterburner systems, afterburners with cyclones, or cyclone + multi-cyclone systems are applicable to the coffee roaster. The highest reported eff. was 99.7%

Cyclone on cooler-stoner will reduce emissions by 70% (Ref 075 pg 6.2-1)

$E = (.003 \times 5.9) + (.3 \times 1.4)$ lb/ton

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Computation Sheet for Emission Factors

Calculations Done By D. Massone Date 9-16-74

Source Coffee Roasting

Particulate cont'd

E_H: $E_H = E = .0177 + .42 \approx .44$ lb/ton

This represents an overall eff. of $\frac{7.5 - .44}{7.5} = .939$
or ≈ 94% eff.

$\boxed{E_H \approx .44 \text{ lb/ton "green" beans}}$

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Computation Sheet For Emission Factors

Calculations Done By 2) Marrone Date 9-16-74

Source Coffee Roasting

Hydrocarbons

E_U : Ref 075 Table 6.2-1

Emissions of aldehydes and organic acids will represent the hydrocarbon emissions from the roaster ;

$E = (.2 + .9)$ lb/TON $=$ 1.1 lb/TON

$\boxed{\therefore E_U = 1.1 \text{ lb/TON}}$

E_N : Using a cyclone-afterburner system on the roaster will effectively eliminate particulate emission however, it should be effective in reducing organic compounds (to CO_2 & H_2O) provided the incineration temp is high enough. We assume a 99.5% eff for hydrocarbon reduction

$E = .005 \times E_U = .005 \times 1.1 =$

$\boxed{\therefore E_N = .0055 \text{ lb/TON coffee beans}}$

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Computation Sheet For Emission Factors

Calculations Done By W. Mamons Date 9-16-74

Source Coffee Roasting

NOx

E_u : Ref. 075 Table 6.2-1

Roaster emission only $E_u = .1$ lb/TON

$$\boxed{E_u = .1 \text{ lb/TON}}$$

Controls for coffee roasters applicable to NOx emissions generally are not a state of the art. We may judge the maximum effect of NOx from this industry by assuming $E_N = 0$
In this case $T_s - T_N$ would be maximized

$$\boxed{E_N = 0}$$ change

2-6-75 WMM

Ref. 242 p 7-13

If we may apply NOx reduction from combustion sources in [illegible] program then we would expect at least a 50% reduction

$$(E_N = .5 \times E_u = .05 \text{ lb/TON})$$

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Computation Sheet For Emission Factors

Calculations Done By V.G. Russo Date Oct 4, 74

Source Coffee Roasting

Particulates:

Ref 006 lists the "breakdown" of plants by state. Eighteen states are represented. Only 2 two states are not in the "top" 25 states based on population. These 2 states (Oklahoma and Oregon) have only 6 total plants from 268 national plants. ∴ Use 50 state average.

$$\text{Average plant size} = \frac{A}{268} = \frac{1.55\times10^6}{268}\ \text{TONS/YR-plant}$$

$$\cong 5785\ \text{TONS/YR/PLANT}$$

Assuming, 16 HR/DAY, 7 DAYS/WK "Operation"

$$\text{Process Weight Rate} = \frac{5785\ \text{TONS/YR-PLANT}}{16\ \text{HR/DAY}\ 7\ \text{DAY/WK}\ 52\ \text{WK/YR/PLANT}}$$

$$\cong 1990\ \text{lbs/HR}$$

Allowable Emissions = 41 lbs/HR-PLANT

$$E_S = \frac{41\,(\text{lbs/HR})(16\ \text{HR/DAY})(7\ \text{DAY/WK})(52\ \text{WK/YR})\ 268\ \text{Plants}}{1.55\times10^6\ \text{TONS/YR}}$$

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Computation Sheet For Emission Factors

Calculations Done By V. F. Russo Date Oct 4, 1974

Source Coffee Roasting

PARTICULATES: (cont.)

$\therefore E_s = 0.794$ lbs particulate/ton

HYDROCARBONS:

The HC emissions resulting from Roasting are aldehydes and organic acids. Since these emissions do not involve a solvent, the regulations are inapplicable.

$\therefore$ $m = 0$
$n = \text{ALL}$

$$\therefore E_s = E_u \sum_{i=1}^{ALL} A_i = E_u$$

Hence for HC

$E_s = 1.1$ lbs/ton

NO$_x$ Emissions:

There are no regulations applicable to coffee Roasting

$\therefore E_s = E_u = 0.1$ lbs/ton

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Computation Sheet For Industrial Factors

Calculations Done By Hooper Date 1/22/76

Source Deep Fat Frying

Ref ㉔ p2-9 gives 1975 production of foods that have been deep fat fried. This same ref (p 3-8) states that the pollution problem relates to the moisture content of the food. That is, if the % moisture is < 20%, there should be no emission problem. Potato chips, sticks, french fries & donuts have a moisture content > 20%, so for the purpose of this study, we will consider the frying of these items only.

From p 2-9 of Ref ㉔

1975 Production (items > 20% moisture) = 4.279×10^9 LBS

1980 Production (" " ") = 5.289×10^9 LBS

Assuming compound growth

$$P_c = \sqrt[5]{\frac{5.289}{4.279}} - 1.0 = 0.0433$$

$$\boxed{P_c = 0.0433}_{\text{compound}}$$

Ref (144) p 48 gives a K for the food industry of 81% (avg between 1965 & 1973). We will assume this value to hold.

$$\boxed{K = 0.81}$$

$$A = \frac{4.279 \times 10^9}{(0.81)(2000)} = 2.641 \times 10^6 \text{ tons}$$

$$\boxed{A = 2.64 \times 10^6 \text{ tons of food processed}}$$

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Computation Sheet For Industrial Factors

Calculations Done By HaRBE Date 1/28/78

Source Deep Fat Frying

For P_B, we will use twice the IRS allowable depreciation rate.

From Ref ㊼ p31, the allowable is 18yrs for "Vegetable oils and vegetable oil products.

$$P_B = \frac{1}{(2)(18)} = 0.0278$$

$$\boxed{P_B = 0.0278}$$ simple

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Computation Sheet For Emission Factors

Calculations Done By Homer Date 1/28/75

Source Deep Fat Frying

Part

Ref (16) p 301 gives a particulate emission factor "normally less than 0.1 gr/scf, which is well below common limits for particulate emissions."

Ref (24) p 5-6 states that a scrubber system would require 1000 - 4000 cfm typically. If we assume the avg. 2500 cfm

$$\frac{\left(0.1\ \frac{gr}{scf}\right)\left(2500\ \frac{ft^3}{min}\right)\left(60\ \frac{min}{hr}\right)}{7000\ gr/lb} = 2.14\ lb/hr \text{ from a typical fryer}$$

Ref (24) p 2-5 gives 145 potato chip plants in 1966.

The production for that year can be determined thusly:

1969 Potato chip production = 886×10^6 lbs Ref (21) p 2-2

$$886\times10^6 = P_{1966}\left[1+.0433\right]^3$$

$$1966\ Prod = 780\times10^6\ lbs = .39\times10^6\ \frac{tons}{yr}$$

$$\frac{0.39\times10^6\ tons/yr}{145\ plants} = 2689.7\ \frac{ton}{yr\text{-}plant}$$

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Computation Sheet For Emission Factors

Calculations Done By [illegible] Date 1/22/75

Source Deep Fat Frying

Ref (24) p 3-8 states that the avg potato chip plant has 1-6 cookers. Assuming 3 cookers, 16 hrs/day, 6 days/wk, 52 wks/yr

$$\frac{2689.7}{3} = 896.6 \frac{\text{tons}}{\text{yr plant}} \qquad \frac{(896.6)(2000)}{4992} = 359 \text{ lb/hr}$$

$$\frac{[illegible]}{359} = 11.9 \text{ lb/ton raw processed}$$

$$\boxed{E_{U_{part}} = 11.9 \text{ lb/ton chips processed}}$$

Ref ([illegible]) p 800,801 indicates that incineration has been an acceptable technique to control emissions since practically all are combustible.

We will assume an $\eta = 99\%$

$$E_{C_{part}} = (1-.99)(11.9) = 0.119$$

$$\boxed{E_{C_{part}} = 0.119 \text{ lb/ton raw processed}}$$

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Computation Sheet For Emission Factors

Calculations Done By [illegible] Date 1/22/75

Source Deep Fat Frying

Ep

Particulate must be controlled by gen'l regs for particulate emissions.

Using the gen'l PWR generator from Refs (84) & (148)
for a PWR of 559 lb/hr, the allowable is 1.99 lb/hr

$$E_{part} = \frac{(1.99)(2000)}{559} = 7.13 \text{ lb/ton}$$

$$\boxed{E_{part} = 7.13 \text{ lb/ton food processed}}$$

Hydrocarbons

No emission data on hydrocarbons is available; however, emissions have been reported and are known to be a problem. (Ref (84) p 3-2, 3-4)
We will **ASSUME** an emission factor equal to that for vegetable oil mfg (See "Emission Factors - Vegetable Oil Production")

$$E_v = 38 \text{ lb/ton veg. oil}$$

Ref (84) p 2-9 gives the oil/fat content of the food fried

$$\frac{874 \times 10^6 \text{ lbs oil}}{4279 \times 10^6 \text{ lbs product}} = 0.204 \frac{\text{lb oil}}{\text{lb prod.}}$$

$$E_{v_{HC}} = (38)(.204) = 7.75 \text{ lb/ton food processed}$$

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Project Number - 32231 New Source Performance Standards

Computation Sheet For Emission Factors

Calculations Done By Hunter Date 1/22/75

Source Deep Fat Frying

$$\boxed{E_{U_{HC}} = 7.75\ \text{lb}/\tfrac{\text{ton}}{\text{food processed}}}$$

Using incineration & assuming an $\eta = 99\%$

$$E_{N_{HC}} = (1-.99)(7.75) = 0.078\ \text{lb/ton}$$

$$\boxed{E_{N_{HC}} = 0.078\ \text{lb}/\tfrac{\text{ton food}}{\text{processed}}}$$

Hydrocarbons are generally controlled by odor nuisance regs, if at all.

From Ref ㉔ p3-2, out of 76 potato chip plants, there were 15 odor complaints. Assuming that these 15 represent, ultimately, control to the level of E_N and the remaining 61 represent no control (E_U)

$$E_{S_{HC}} = \left(\frac{15}{76}\right)(.078) + \left(\frac{61}{76}\right)(7.75) = .015 + 6.22$$

$$\boxed{E_{S_{HC}} = 6.24\ \text{lb}/\tfrac{\text{ton food}}{\text{processed}}}$$

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Project Number - 32391 New Source Performance Standards

Computation Sheet For Industrial Factors

Calculations Done By Harper Date 1/9/75

Source Direct Firing Of Meats

Since no "production" values could be located, it will be necessary to develop the factors on a different basis — the number of units since this value is available (partially)

Ref (50) p 3 is reproduced on the attached graph. We will assume that the growth of Hardee's in terms of the number of units parallels the growth in revenues as is the case for McDonalds. This assumption is necessary because

① Only unit data for one year (1972) is known for Hardee's (565)

② McDonalds is a similar industry but does not fire meat directly

Based on the attached curve, the # of units @ Hardee's in 1975 is about 700

This corresponds to a growth rate of

$$\frac{700 - 565}{(3)(700)} = 6.4\ \%$$

Ref (50) p1 indicates that in 1966 there were 26,000 gas-fired broilers in the U.S. Since Hardee's is a "growth" industry & it represents only a small % of the total, it would be unreasonable to assume this value for P_c. Population growth might be another factor to consider. However, there are reasons why this value might be too low; the # of fast food chains using direct heat firing is increasing faster than the population and there is an increasing trend for Americans to eat out.

We will assume the growth in this industry as follows:

$$P_c = (2/3)(P_{pop}) + 1/3\,(P_{Hardee's})$$

$$P_{pop} = 1.8\%$$ (See "Industrial Factors - Dry Cleaning")

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Project Number - 32391 New Source Performance Standards

Computation Sheet For Industrial Factors

Calculations Done By Harvey Date 1/8/74

Source Direct Firing C/I Means

$$P_c = (.667)(0.018) + (.333)(.064) = .012 + .021 = 0.033$$

$$\boxed{P_c = 0.033}$$ simple

In 1966, there were 26,000 units

In 1975, the no. of units would be

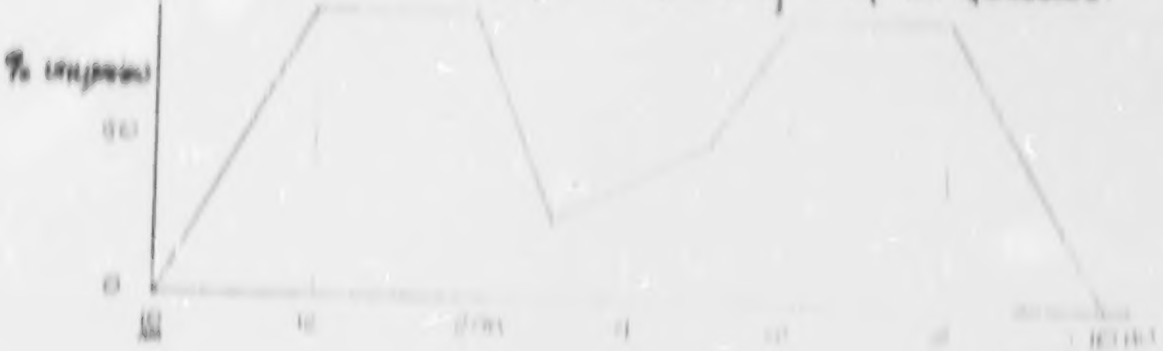
$$(26000)\left[1+(9)(.033)\right] = 33,722$$

Since emission factors will be in terms of lb/yr-unit based on emissions during peak operation, 33,722 units can be considered capacity & K will scale the results to a typical "production rate" consistent with realistic operation

$$\boxed{A = 33,722 \text{ units}}$$

K = f(typical daily operational schedule)

We will assume a "typical" operating day as follows:



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Project Number - 32391 New Source Performance Standards

Computation Sheet For Industrial Factors

Calculations Done By [illegible] Date 1/8/85

Source Direct Firing Of Meats

The avg utilization on this curve is 62%

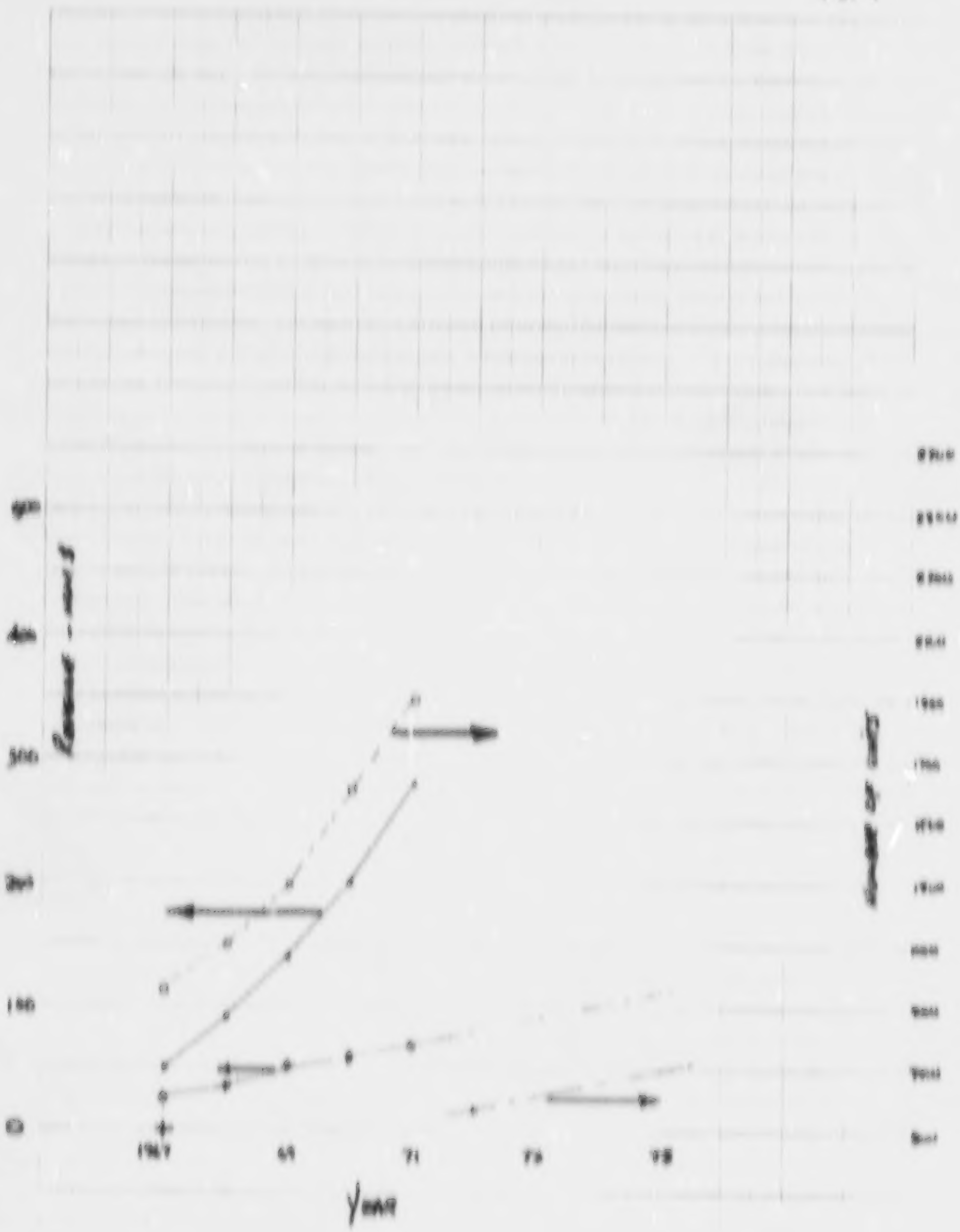
$$K_{avg} = \frac{\Sigma \text{ Area under curve}}{18 \text{ hrs}}$$

$$\boxed{K = 0.62}$$

The IRS depreciation guideline for "Wholesale and Retail Trade including assets used in .... the operation of restaurants" is 10 yrs. Assuming twice the allowable Ref (37) p 42

$$P_B = \frac{1}{(2)(10)} = 5.0\%$$

$$\boxed{P_B = 0.05}$$ simple


500
400
300
200
100
0
1967
69
71
73
75
Year

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Computation Sheet For Emission Factors

Calculations Done By Hunter Date 1/8/75

Source Direct Firing Of Meats

Particulates

Ref ([illegible]) p 4 Results of emission tests @ Hardee's (peak operation)

$$3\ \frac{\text{TEST}}{\text{AVG}} = \frac{0.641 + .486 + .757}{3}\ \text{lb/hr} = 0.628\ \text{lb/hr}$$

Ref (254) p 3 Additional Hardee test

If we assume $\overset{0.726}{\text{that}}$ E_u equals the average

$$E_u = (.641 + .486 + .757 + .726)/4 = 0.653\ \text{lb/hr per unit}$$

If we assume

12 hrs/day, 6 days/wk, 52 wks/yr

then, the yearly emission rate based on peak operation is

$$0.653\ \frac{\text{lb}}{\text{hr unit}} \times 12 \times 6 \times 52 = 2444.8\ \frac{\text{lb}}{\text{yr unit}}$$

$$\boxed{E_{u_p} = 2444.8\ \frac{\text{lb}}{\text{yr unit}}}$$

Ref ([illegible]) describes an ESP that was installed @ a Hardee's to reduce particulate emission. We will assume that this or a similar unit would be used. The vendor quotes an SCFM = 1400 with an associated η = 92%

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Computation Sheet For Emission Factors

Calculations Done By Hansen Date 1/8/75

Source Deep Frying Of Meats

$\therefore E_{H_p} = 2444.8(1-.92) = 195.6$

$$\boxed{E_{H_p} = 195.6 \frac{\text{lb}}{\text{unit-yr}}}$$

Ref (50) p5 N.C. is the only State (presently) attempting to enforce a visible emissions reg'n. No states appear to be enforcing a part. reg (if applicable). Assume, ∴ that $E_{S_p} = E_U$

$$\boxed{E_{S_p} = 2444.8 \frac{\text{lb}}{\text{unit-yr}}}$$

Hydrocarbons

Ref (51) p6 gives CH_2O emissions from a Hardee's test during the noontime peak. The avg during this peak period is 1.49 lb/hr

Ref (51) p7 gives CH_4 emissions (avg) as 0.149 lb/hr

$\text{TOTAL} = 1.639 \frac{\text{lb}}{\text{hr}\cdot\text{unit}}$

$E_{U_{HC}} = 1.639 \times 12 \times 6 \times 52 = 6136 \frac{\text{lb}}{\text{yr}\cdot\text{unit}}$

$$\boxed{E_{U_{HC}} = 6136 \frac{\text{lb}}{\text{yr}\cdot\text{unit}}}$$

Ref (54) p4 gives an avg emission (Hardee's test with an oxidizer [illegible]) of CH_2O = 0.64. If we assume that the CH_4 value is 1/10 that of the CH_2O (as was the case for the uncontrolled results)

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Computation Sheet For Emission Factors

Calculations Done By Homer Date 1/8/75

Source Direct Firing of Meats

Then the total = .0064 + .064 = 0.0704

$$.0704 \times 12 \times 6 \times 52 = 2636 \ \frac{lb}{yr \cdot unit}$$

$$\boxed{E_{HC} = 2636 \ \frac{lb}{yr \cdot unit}}$$

$$\eta = \frac{6136 - 2636}{6136} = 57\%$$

Incineration has been employed but its costs are excessive & could not be considered an economically feasible control method. Again, N.C. is the only State (presently) attempting to enforce odor nuisance regs to control HC's. Considering the number of units throughout the U.S., we will assume E's as:

$$\boxed{E_{HC} = 6136 \ \frac{lb}{yr \cdot unit}}$$

This entire analysis is based on the fact that all units are similar in size to the two units tested @ [illegible]

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Computation Sheet For Industrial Factors

Calculations Done By Hopper Date 3/1/79

Source Feed Milling

THE PURPOSE OF FEED MILLING IS TO REDUCE CEREAL GRAINS & MEALS TO A DESIRED SIZE & CONSISTENCY & TO MIX THEM WITH OTHER INGREDIENTS.

FEED MILLING CAN BE BROKEN DOWN INTO TWO CATEGORIES

(a) ALFALFA DEHYDRATING

(b) OTHER WHICH INCLUDE WHEAT, GLUTEN, RICE, BREWER'S & DISTILLERS DRY GRAINS & DRIED BEET PULP

1968 PRODUCTION FIGURES — REF (49) TAB 8.2 p 93

(a) 1.6×10^6 TONS DRY MEAL — REF (49) TAB 8.8 p 93

(b) 8.4×10^6 " " "

REF (28) p 4-81

$\boxed{P_c = 3.5\%}$ ASSUME COMPOUND

REF (1) STATES $P_c = 1.5\%$ FOR GRAIN HANDLING WHICH WOULD ENCOMPASS SIMILAR GROWTH TRENDS

WE CONCLUDE THAT $P_c = 3.5\%$ IS MORE REALISTIC SINCE IT IS COMPARABLE TO THE U.S. POPULATION GROWTH TRENDS UPON WHICH THE DEMAND WOULD BE BASED.

$$1975 = 1968(1+P_c)^7$$

$$A_b = (8.4 \times 10^6)(1.035)^7 = 10.69 \times 10^6$$ TONS DRY MEAL FOR ALL OTHER FEED MILLING PROCESSES

$$A_a = (1.6 \times 10^6)(1.035)^7 = 2.04 \times 10^6$$ TONS DRY MEAL FOR ALFALFA DEHYDRATING

$\boxed{K = 0.6}$ REF (28) p 4-81

THIS VALUE COULD BE FURTHER DEFINED IF MORE INFO IS FOUND IN THE LITERATURE.

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Computation Sheet For Industrial Factors

Calculations Done By [illegible] Date 8/1/78

Source Feed Milling

$$A_{minimum} = \frac{2.04\times10^6}{0.5} = \boxed{4.08\times10^6 \text{ tons dry grain} = A}$$

$$A_{maximum} = \frac{10.69\times10^6}{0.5} = \boxed{21.38\times10^6 \text{ tons dry grain} = A}$$

REF (30) INDICATES
1969 PRODUCTION
OF 30×10^6 TONS

IF NECESSARY, THIS VALUE
& THE TONS OF DRY GRAIN FOR THE
SAME YEAR CAN BE USED TO RELATE
TO E_S

NOTE: REF ① SHOWS
U.S. MAP LOCATING
GRAIN ELEVATORS. THIS
COULD BE USEFUL IN
SYNTHESIZING E_S.

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Computation Sheet For Industrial Factors

Calculations Done By W. Marrone Date 9-26-74

Source Feed Milling

P_B : The obsolescence rate for both the "Alfalfa" and "other" portions of the Feed Milling Industry are assumed identical and will be estimated as follows;

Ref 037 pg 31 Sec 20.1

Avg depreciation period = 17 yrs

P_B is est by 2×IRS = 34 yrs

100% depreciation in 34 yrs or $\frac{100\%}{34\,yr} \Rightarrow 2.9\%/yr$ simple

$\therefore P_B = .029$ simple

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Project Number - 32391 New Source Performance Standards

Computation Sheet For Emission Factors

Calculations Done By Homer Date 3/1/74

Source Feed Milling

$$\boxed{E_{U_{ALFALFA}} = 50\ \#/\tfrac{\text{TON DRY}}{\text{MEAL}}}$$ REF ⓸⓻ p 60 TAB 4.1-1

$E_{U_{OTHER}}$ = 1% OF PRODUCTION

$$\frac{\left(8.364\times10^{6}\ \frac{\text{TONS MEAL}}{\text{YR}}\right)\left(\frac{\#\ \text{PART}}{\text{TON MEAL}}\right)}{\left(2000\ \frac{\#\ \text{PART}}{\text{TON MEAL}}\right)} = \frac{\text{TONS PART}}{\text{YR}} = (8.364\times10^{6})(.01)$$

$$\frac{\#\ \text{PART}}{\text{TON}} = \boxed{20\ \#/\text{TON} = E_{U_{OTHER}}}$$

THESE EMISSIONS ARE AFTER THE 1ST COOLING CYCLONE WHICH IS COMMON TO ALL DEHYDRATORS

FROM REF ⑦⑦ P 225 TAB 76

$E_N = f(\eta = 97.8\%)$ FABRIC FILTER SYSTEM

$$E_{N_{ALFALFA}} = 50(1-.978) = \boxed{1.1\ \#/\tfrac{\text{TON}}{\text{DRY MEAL}} = E_{N_{ALFALFA}}}$$

$$E_{N_{OTHER}} = 20(1-.978) = \boxed{0.44\ \#/\tfrac{\text{TON}}{\text{DRY MEAL}} = E_{N_{OTHER}}}$$

see P3

REF ②⑧ P 4-80 STATES
η = 95% WE MAINTAIN THAT 97.8% IS FEASIBLE SO E_N WILL BE BASED ON IT.

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Computation Sheet For Emission Factors

Calculations Done By [illegible] Date 2

Source Feed Mixing

Additional info.:

Ref (50) states $\eta = 99.5\%$

$\therefore E_{Al_{maxim}} = 50(1-.995) = \boxed{0.25\ \frac{\#}{ton} = E_{Al_{maxim}}}$

$E_{Al_{other}} = 20(1-.995) = \boxed{0.1\ \frac{\#}{ton} = E_{Al_{other}}}$

Therefore, these #'s will be used

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Computation Sheet For Emission Factors

Calculations Done By Hopper Date 10/14/74

Source Feed Milling

Determination of Eo:

Ref (001) p85, Fig 8.1 gives geographical distribution of the 11,147 grain elevators existing in 1969. If we assume that the distribution of feed milling plants is the same, then we will have the following distribution

Kansas = 1209/11,147 = 10.8 %
Illinois = 1114/11,147 = 10.0 %
Iowa = 1076/11,147 = 9.7 %
Nebraska = 883/11,147 = 7.9 %
Texas = 806/11,147 = 7.2 %
N. Dak = 774/11,147 = 6.9 %
Minn = 768/11,147 = 6.9 %
Miss = 499/11,147 = 4.5 %
63.9 %

The remaining 36.1% are uniformly distributed throughout the rest of the country

Several states have regs for Feed/Grain Processing. The following states regs apply to feed specifically:

Illinois = 0.3 grains/scf
Iowa = 0.1 "

We will assume that acceptable particulate emissions will be a function of the year & particulate regs for the remaining 8 states. For the remaining 36.1%, we will use the "generalized" process weight table.

Ref (21) p 4-31 gives rule of thumb of
1.38 acfm throughput for hundredweight production per day.
If we assume acfm ≈ scfm, then

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Computation Sheet For Emission Factors

Calculations Done By Hoppe Date 10/14/80

Source Feed Mixing

$$\frac{\left(\frac{gr}{scf}\right)\left(\frac{ACF}{min}\right)\left(60\frac{min}{hr}\right)\left(24\frac{hrs}{day}\right)}{(cwt)\left(\frac{0.05\ tons}{cwt \cdot day}\right)\left(7000\frac{gr}{\#}\right)} = \frac{1}{\frac{tons}{\#}} = \frac{\#}{ton}$$

for Illinois,

$$\frac{(0.3)(1.38)(60)(24)}{(.05)(7000)} = 1.70\ \frac{\#}{ton} = EF_{ILL}$$

for Iowa

$$= \frac{1.70}{3} = 0.567\ \frac{\#}{ton} = EF_{IOWA}$$

for Kansas (Ref (34) p 29 Tab III)

"Typical" plant size = 10,350 #/hr (Ref (001) p 4 Tab 3.4)

$EF_{KANSAS} = f(12.0\ \#/hr)$

$$\frac{(12.0)(2000)}{(10,350)} = 2.32\ \#/ton$$

For Nebraska,

$EF = f(9.73\ \#/hr)$

$$\frac{(9.73)(2000)}{10,350} = 1.88\ \#/ton$$

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Computation Sheet For Emission Factors

Calculations Done By [illegible] Date [illegible]

Source Feed Milling

for Texas

$$E_s = f(15.2\ \#/hr)$$

$$\frac{(15.2)(2000)}{10{,}350} = 2.94\ \#/ton \qquad *$$

N. Dakota

$$E_s = f(12.0\ \#/hr) = 2.32\ \#/ton \qquad *$$

for Minn

$$E_s = 2.32\ \#/ton \qquad *$$

for Mississippi

$$E_s = 2.32\ \#/ton \qquad *$$

for all States (gen'l)

$$E_s = f(11.5\ \#/hr) \qquad *$$

$$\frac{(11.5)(2000)}{10{,}350} = 2.22\ \#/ton \qquad *$$

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Project Number - 323P1 New Source Performance Standards

Computation Sheet For Emission Factors

Calculations Done By Hyman Date 10/12/74

Source Feed Milling

$$ES_{tot} = (.108)(2.32) + (.100)(1.70) + (.097)(.567) + (.079)(1.79)$$
$$+ (.072)(2.94) + (.069)(2.32) + (.069)(2.32) + (.047)(2.32)$$
$$+ (.341)(2.35)$$

$$= .2506 + .1700 + .0550 + .1415 + .2117 + .1601 + .1601 + .1084$$
$$+ .8014 = 2.062 \frac{lb}{ton}$$

$$\boxed{\overline{E}_{S_{feed\ mill}} = 2.062 \frac{lb}{ton}}$$

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Project Number - 32391 New Source Performance Standards

Computation Sheet For Industrial Factors

Calculations Done By William Massone Date 9-19-74

Source Fish Meal Processing

P_c:

Ref 050 "Fish Meal Processing" pg 2 (1971)

"No additional plants are forecast for the next five years."

We have no information on growth during the bulk of the period 1975 → 1985 however since little expansion is occurring in the near future we make the assumption that any growth in 1975 - 1985 would be insignificant, ⇒ $P_c = 0$

$$\boxed{P_c = 0}$$

This assumption is not great especially if we ref to Fig 1 of the above Ref. Fish Meal domestic production has not greatly changed since 1960.

P_B:

Ref 050 pg 1 & 2

1971 Production of Fish Meal = 292,429 TON

No of Fish Meal Plants = 123

$$\text{Avg size of plant industry-wide} \approx \frac{292{,}429 \text{ ton/yr}}{123 \text{ plant}} = 2{,}377 \ \frac{\text{ton/yr}}{\text{plant}}$$

Assuming that $P_c = 0$ we may state that the 1975 production of fish meal is equivalent to the 1971 level of 292,429 ton/yr

$$P_{75} = 292{,}429 \ \frac{\text{Ton}}{\text{yr}} \text{ fish meal}$$

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Computation Sheet For Industrial Factors

Calculations Done By W. Meserve Date 9-19-77

Source Fish Meal Processing

P_R cont'd

As stated in the above reference, one fish meal plant will be replaced annually over the next five years. We assume this to be true for 1975-1985 with a simple decay rate based on the 1975 baseline year this calculates out to;

Avg size plant 2,377 ton/yr

1975 Prod Fish Meal 292,429 ton/yr

n = 1 $P_R = \frac{2,377}{292,429} = .008$ simple

K:

Fish meal production is a sub-industry of the whole fish processing market, however for the most part it is associated with the fish canning (seafood processing) industry. We will make the analogy that capacity utilization in fish meal plants will parallel fish canneries or food plants in general.

Ref. 144 pg 48 July 1974 Avg K for 1965-1973 Table 1 for Food Mfg = .81

∴ K = .81

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Computation Sheet For Industrial Factors

Calculations Done By W. Marrone Date 9-19-74

Source Fish Meal Processing

A: Using the 1975 Production of 292,429 Ton/yr of Fish Meal and the capacity utilization of .81 (K) we are able to calculate the 1975 Production Capacity

$$A = \frac{P_{75}}{K} = \frac{292,429}{.81} \text{ Ton/yr}$$

$$\boxed{A = 361,025 \text{ Ton/yr Fish Meal}}$$

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Project Number - 32391 New Source Performance Standards

Computation Sheet for Emission Factors

Calculations Done By W. Masrone Date 9-19-74

Source Fish Meal Processing

Particulates

E_u: Ref 075 Table 6.6-1

Drier Emissions .1 lb/Ton of Fish scrap

If we refer to Ref 076 pg 806 we obtained information on the character of scrap feed to the fish meal plant.

Charge material ≈ 20-30% solids

We will assume for this source that the feed is 25% solids and this solid represents the total fish meal produced. Another way of representing this is by;

$$.25 \frac{\text{Ton Fish meal}}{\text{Ton Fish Scrap}}$$

Converting $\frac{.1 \text{ lb}}{\text{Ton Fish Scrap}}$ to lb/Ton Fish meal

$$E = \frac{.1 \text{ lb}}{\text{Ton Fish scrap}} \times \frac{\text{Ton Fish Scrap}}{.25 \text{ Ton Fish Meal}}$$

$$\boxed{E_u = .4 \text{ lb/Ton Fish Meal}}$$

This value is suggested as representing the emission after the cyclone normally integral with fish meal driers.

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Computation Sheet For Emission Factors

Calculations Done By W. Marrone Date 9-19-74

Source Fish Meal Processing

Particulates cont'd

E_{11}:

cyclones are generally applied and achieve 90% eff
Ref 050 pg 3-4 "Fishmeal Processing"

$E_{11} = .1 \times E_{11} = .1 \times .4$ lb/ton fish meal

$$\boxed{E_{11} = .04 \text{ lb/TON Fish Meal}}$$

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Computation Sheet For Emission Factors

Calculations Done By W. Marrone Date 9-19-94

Source Fish Meal Processing

H_2S

Sulfide emissions are identified and quantified from cookers in the fish meal plant Ref. 075
Table 6.6-1

$E = .01$ lb H_2S/ton Fish Meal (Fresh Fish)

and $E = .2$ lb H_2S/ton Fish Meal (Stale Fish)

In many cases, fish meal plants will be in close proximity or an integral part of fish canneries so that stale fish would not represent a major portion of the scrap input. We assume the following split as representative.

25% Stale Scrap
75% Fresh Scrap

A weighted emission factor is determined by;

$E = .75(.01) + .25(.2)$

$E = .058$ lb/ton Fish Meal

$\boxed{E_4 = .058 \text{ lb/ton fish meal}}$

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Computation Sheet for Emission Factors

Calculations Done By W. Marrone Date 9-19-74

Source Fish Meal Processing

H_2S / cont'd

Control of fish meal driers to remove odorous compounds is accomplished by thermal incineration, condenser + afterburners, and chlorinating - scrubber systems.

H_2S and $(CH_3)_3N$ [Trimethylamine] are odorants which have been identified (Ref 075 pg 6.6-1) from cookers.

We assume that an odor control system will be comparatively effective with respect to H_2S removal.

Ref 076 pg 3

Efficiencies of ≈ 99% are achievable

$E_H = .01 \times E_U = .01 \times .058$ lb/ton

E_H ≈ .0006 lb/TON Fish Meal

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Computation Sheet For Emission Factors

Calculations Done By D. Massone Date 10-16-74

Source Fish Meal Processing

E_0: Particulates

A breakdown of fish meal capacity statewide was not obtained however we surmise that it will at least occur in those states bordering on the major fishing waters, including the Atlantic & Pacific Oceans, the Gulf of Mexico, and the Great Lakes. We will not consider the latter as a major contributing area. Those states therefore which would conceivably support a fish processing industry are listed as follows;

Alaska
Washington
Oregon
California
Texas
Louisiana
Mississippi
Florida
Georgia
Alabama
Hawaii

South Carolina
North Carolina
Virginia
Maryland
Delaware
New Jersey
New York
Massachusetts
Maine
Rhode Island

This represents essentially half of the states and if we assume that the emission "table" generated by assimilating the process weight guidelines of these 21 states would not differ appreciably from the 50 state average (General Process weight rate curve) we may calculate the allowable emissions as follows;

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Computation Sheet For Emission Factors

Calculations Done By D. Marrone Date 10-16-79

Source Fish Meal Processing

E_s: Particulates

Typical Plant size = 2,377 T/yr
(see P_s)

If we assume an operating schedule of 8 hrs/day 350 d/yr
8×350 = 2800 hr/yr

$$\frac{2377 \text{ T/yr}}{2800 \text{ h/yr}} = .849 \text{ T/hr} \text{ or } \approx 1700 \text{ lb/hr}$$

process weight

Allowable emission from "General Process Weight Curve"

E_A = 3.7 lb/hr

using this allowable emission rate and the typical drier weight rate we may estimate E_s for Fish Meal Drying

$$E_s = \frac{3.7 \text{ lb/hr PT}}{.849 \text{ Ton/hr Meal}} = 4.36 \text{ lb/Ton Meal}$$

so E_s = 4.36 lb/Ton Fish Meal

Since this value of E_s is much higher than the uncontrolled source (E_u = .4 lb/Ton) we

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Computation Sheet For Emission Factors

Calculations Done By R.J. Marrone Date 10-16-74

Source Fish Meal Processing

E_s : Particulates cont'd

must assume the value to be used for E_s should be E_u

$$\boxed{E_s = E_u = .04 \text{ lb/ton}}$$

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Computation Sheet for Emission Factors

Calculations Done By W. Marrone Date 10-16-74

Source Fish Meal Processing

E_6: H_2S

Ref's 148 and 84

There are apparently no hydrogen sulfide limitations which may be applied to fish meal processing plants in the SIP's.

In this instance $E_6 = E_u$

$$\therefore \boxed{E_6 = .058 \text{ lb/ton fish meal}}$$

Project Number - 32391 New Source Performance Standards

Computation Sheet For Emission Factors

Calculations Done By W. Massena Date 11-1-79

Source Fish Meal Processing

E_{111d} : H_2S

Application of control systems (condenser - afterburner, incinerator, or chlorinator scrubbers) is assumed to be equally feasible on existing fish meal plants as for new plants such that $E_{111d} = E_N$

E_{111d} = .0006 lb/ton fish meal

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Computation Sheet For Industrial Factors

Calculations Done By Homer Date 1/23/78

Source Grain Handling & Processing

This source category is unusual in that the product (of which there are many types) is handled many times, each resulting in an emission of particulate matter. For the purpose of this study, we will define industrial & emission factors for the following categories:

① Loading, unloading, transferring, conveying
② Screening, cleaning
③ Drying
④ Processing

Values of A & P_0 will reflect actual production, growth & capacity utilization. The emission factors will reflect the multiple handling aspects.

Ref (1) p 53 gives 1968 production of 177×10^6 tons of grain
Ref (1) p 54 gives the growth rate of 1.5% (Assume compound)

Ref (97) p 91 indicates that 83% of the grain produced goes through country elevators

Ref (144) p 18 indicates the avg K for the flour industry (1965-1973) is 81%. If we assume that country elevators could handle 100% of the grain produced & take the avg of these two data sources,

$$\boxed{K = 0.82}$$

Assume valid for all categories

We will assume that all the grain produced is loaded & handled, etc, screened, etc & processed, then

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Computation Sheet For: Industrial Factors

Calculations Done By Hopper Date 1/23/75

Source Grain Handling & Processing

$$A = \left(\frac{177\times10^6}{0.82}\right)\left(1+.015\right)^7 = 239.6\times10^6$$

$$\boxed{A_{1985} = 239.6\times10^6 \text{ tons}}$$

Ref ㊼ p 22 indicates that only 20% of the grain produced is dried

$$A_{drying} = (239.6\times10^6)(0.20) = 47.9\times10^6$$

$$\boxed{A_{drying} = 47.9\times10^6 \text{ tons}}$$

$$\boxed{P_c = 0.015}$$ [illegible] Assume value for all categories

From Ref ㊲ p 30, the IRS allowable depreciation guideline for "Agriculture ... Machinery and equipment, including grain bins ..." 10 yrs

Ref ㊲ p 31 "Grain and grain mill products ...." 17 yrs

Assuming twice the avg of the above values

$$P_b = \frac{1}{2\frac{(17+10)}{2}} = 0.037$$

$$\boxed{P_b = 0.037}$$ [illegible] Assume value for all categories

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Project Number - 32391 New Source Performance Standards

Computation Sheet For Industrial Factors

Calculations Done By [illegible] Date 1/23/75

Source ~~[illegible]~~ Grain Handling & Processing

$\underline{E_u}$

Ref (41) p 82 gives an uncontrolled emission factor for loading, unloading, transferring & conveying of 20 lb/ton grain. This value considers multiple handling.

$$\boxed{E_{u_{\text{handling etc}}} = 20 \ \text{lb/ton grain}}$$

Ref (41) p 82 gives E_u for screening & cleaning (assumed once through)

$$\boxed{E_{u_{\text{screening etc}}} = 6 \ \text{lb/ton grain}}$$

Ref (41) p 83,
$$\boxed{E_{u_{\text{drying}}} = 6 \ \text{lb/ton grain}}$$

Ref (15) p 6.4-2 TAB 6.4-1
Assuming the avg for the processing of [illegible],

$$\boxed{E_{u_{\text{processing}}} = 6 \ \text{lb/ton grain}}$$

$\underline{E_c}$

For loading, unloading, transferring & conveying, proper hooding & ventilation through fabric filters ([illegible] by [illegible] in some cases) would represent BACT. Ref (41) p 26-29.

$$\eta = 99\%^{+}$$

Assuming 99% $E_{c_{\text{handling etc}}} = (1-.99)(20) = 0.2 \ \text{lb/ton}$

Project Number - 32391 New Source Performance Standards

Computation Sheet For Industrial Factors

Calculations Done By [illegible] Date 1/23/75

Source Grain Handling & Processing

$$\boxed{E_{N_{\text{handling etc}}} = 0.2 \ \text{LB}/\text{TON GRAIN}}$$

Assuming that screening & cleaning op'ns can be similarly controlled,

$$E_N = (1-.99)(6.0) = 0.06$$

$$\boxed{E_{N_{\text{screening etc.}}} = 0.06 \ \text{LB}/\text{TON GRAIN}}$$

Ref ① p 25 states ".... dust emission from grain milling arise from handling the raw grain. Emissions from the milling operations, per se, are well contained within the building ...."

∴ We will assume similar control as for handling, etc

$$E_{N_{\text{processing}}} = (1-.99)(6.0) = 0.06$$

$$\boxed{E_{N_{\text{processing}}} = 0.06 \ \text{LB}/\text{TON GRAIN}}$$

Ref ① p 30 Fabric filters are not used on grain dryers because of the high moisture content of the discharged air. A sliding bar cleaning system on a settling screen would appear to have the greatest potential (Ref ① p 32). With a 100 mesh screen, 1.5-2.0 lb/hr of part. emission were det'd for a 2000 bu/hr dryer.

From Ref ① ⑦ an avg emission factor would be 88 lb/hr.

$(88 \text{ lb/hr})(2000 \text{ hr/yr}) \div 2000 = 88 \text{ TPY}$

For an avg emission of 1.75 lb/hr

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Computation Sheet For Emission Factors

Calculations Done By [illegible] Date 1/23/75

Source Grain Handling & Processing

$$E_N = \frac{1.75}{58} = 0.030$$

$$\boxed{E_{H\,drying} = 0.03\ \text{lb}/\text{ton grain}}$$

$\underline{E_3}$ Ref ① p1 There are 11,147 grain elevators in the U.S.
p85 gives the geographical distribution

Kansas — 11.5%
✓ Illinois — 10.0%
✓ Iowa — 9.7%
Nebraska — 7.7%
Texas — 7.7%
N. Dakota — 6.9%
Minn. — 5.9%
Miss. — 4.5%
63.9%

the remaining 36.1% are distributed throughout the U.S.
of the above only Ill. & Iowa have specific regs, the remainder being covered by PWR limitations. From Ref (54) + (48)

Illinois — 0.2 gr/scf for wet corn milling (processing)
Typical data from Ref (1) p81
10,360 lb/hr
5790 SCFM

$$\frac{\left(0.2\ \frac{gr}{scf}\right)\left(5790\ \frac{scf}{min}\right)\left(60\ \frac{min}{hr}\right)\left(2000\ \text{lb}/\text{ton}\right)}{\left(7000\ \frac{gr}{lb}\right)\left(10{,}360\ \text{lb}/\text{hr}\right)} = 1.88\ \text{lb}/\text{ton}$$

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Computation Sheet For Emission Factors

Calculations Done By Hoover Date 1/23/75

Source Grain Handling & Processing

Iowa = 0.1 gr/scf for grain processing

This corresponds to $1.88\left(\frac{1}{3}\right) = 0.627$ lb/ton grain

For the other states mentioned, we will use the PWR eqs; for the remaining 36.1%, we will use the gen'l PWR curve generated from Ref (84) (148)

We will assume 10,000 lb/hr as the PWR for grain processing

Kansas = 12 lb/hr $\frac{(12)(2000)}{10000} = 2.4$ lb/ton

Nebraska = 9.75 lb/hr $\frac{(9.75)(2000)}{10,000} = 1.95$ lb/ton

Texas = 15.2 lb/hr $\frac{(15.2)(2000)}{10,000} = 3.04$ lb/ton

N. Dak. = 12 lb/hr 2.4 lb/ton

Minn. " " 2.4 lb/ton

Miss. " " 2.4 lb/ton

All others 11.6 lb/hr $\frac{(11.6)(2000)}{10,000} = 2.32$ lb/ton

$$E_s = (.108)(2.4) + (.100)(1.88) + (.097)(.63) + (.079)(1.95) + (.072)(3.04) + (.069)(2.4) + (.069)(2.4) + (.049)(2.4) + (.361)(2.32)$$

$$= .2592 + .1880 + .0611 + .1541 + .2189 + .1656 + .1656 + .1176 + .8375 = 2.168$$

$$\boxed{E_{s\,\text{processing}} = 2.2 \text{ lb/ton grain}}$$

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Computation Sheet For Emission Factors

Calculations Done By Hoover Date 1/23/75

Source Grains Handling & Processing

Drying

Ref ① p 8 indicates a "typical" rate of 2000 bu/hr. From pg of these calcs, a factor of 58 lb/bu would yield

(2000)(58) = 116,000 lb/hr (assume 100,000)

Kansas = 46.3/58 = .7983
Ill = 57.3/58 = .9879
Iowa = 46.3/58 = .7983
Nebr = 33.28/58 = .5738
Tex = 82.0/58 = 1.4138
N. Dak = 46.3/58 = .7983
Minn = 46.3/58 = .7983
Mo = 63.7/58 = 1.0983
All grains = 46.0/58 = .7931

$$E_{S\,drying} = (.108)(.7983) + (.100)(.9879) + (.097)(.7983) + (.079)(.5738) + (.072)(1.4138)$$
$$+ (.069)(.7983) + (.069)(.7983) + (.045)(1.0983) + (.361)(.7931)$$
$$= .0862 + .0988 + .0774 + .0453 + .1018 + .0551 + .0551 + .0494$$
$$+ .2861$$

$$\boxed{E_{S\,drying} = 0.771 \ \frac{lb}{ton\ grain}}$$

Handling, etc.

Ref (??) p V-16 gives a typical elevator size as 12,600 lb/hr

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Computation Sheet For Emission Factors

Calculations Done By Hamer Date 1/23/75

Source Grain Handling & Processing

Kans. = (14)(2000)/18,600 × .168 = .2406
Ill. = (8.8)(2000)/18,600 × .100 = .1079
Iowa = SAME AS KANSAS × .097 = .2156
Neb. = (7.5)(2000)/18600 × .079 = .0815
Tex = (8.1)(2000)/18600 × .072 = .1109
N.Dak. = SAME AS KANSAS × .069 = .1533
Minn = " " × .063 = .1533
Miss = " " × .045 = .100
Others = (18.9)(2000)/18600 × .361 = .742

Σ = 1,955

$E_{\underset{etc.}{handling}} = 1.94 \text{ lb}/\text{ton grain}$

Cleaning Screening

Ref (#56) p V-18 gives grain cleaning process weights of 10,000 – 53,000. We will assume an average of 30,000 lb/hr (15 TPH)

Kansas = 28.0/15 × .168 = .1800
Ill. = 10.9/15 × .100 = .072
Iowa = 25/15 × .097 = .1617
Neb. = 19/15 × .079 = .100
Tex. = 44/15 × .072 = .211
N.D. = 25/15 × .069 = .115
Minn = 25/15 × .069 = .115
Miss = 25/15 × .045 = .075
others = 24/15 × .361 = .5776

Σ = 1.607

$E_{\underset{etc.}{cleaning}} = 1.61 \text{ lb}/\text{ton grain}$

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Computation Sheet For Emission Factors

Calculations Done By [illegible] Date 1/24/85

Source Grain Handling & Processing

Summary:

	E_U	E_M	E_I
Handling, etc.	20.0	0.2	1.94
Screening, etc.	6.0	0.06	1.61
Drying	6.0	0.06	0.77
Processing	6.0	0.03	2.16

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Computation Sheet For Industrial Factors

Calculations Done By W. Morrone Date 9-17-74

Source Smoked Meat

K: Ref 144 pg 48
July 1974

Capacity utilization for this industry was not readily obtainable in the literature. The best estimate was obtained from the above reference which listed the [illegible] to 1973 average capacity utilization rate for the manufacturing of food products.

K_{avg} = .81 [illegible] /15 = .83

We use this average value and assume it applicable to meat smokehouses during the period 1975-1985.

$\boxed{K = .81}$

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Computation Sheet For Industrial Factors

Calculations Done By W. Marrone Date 9-17-74

Source Smoked Meat

P_o : Production data was obtained from Ref 004 pg 1-8

Year	Fish Smoked (Ton/YR)	Meat Smoked
1963	49,550	2,300,000
1967	21,400	2,500,000
1968	20,392	N.A.

These data were plotted and appear on the attached graph. In 1963 49,550 / 2,300,000 + 49,550 ≈ 98% of smoked production was meat and similarly in 1967, 99% of production was meat.

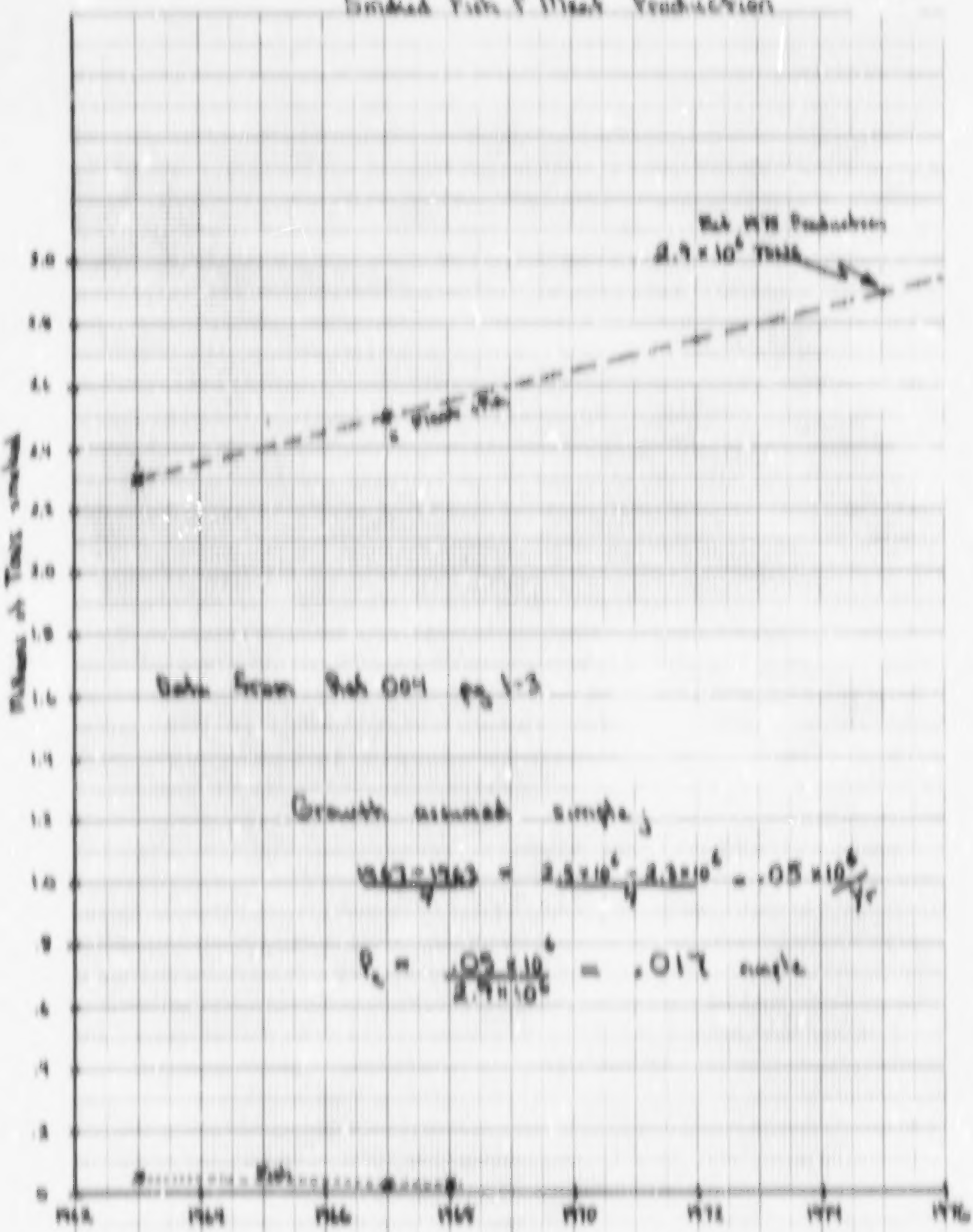
We estimate that the slow growth during the period 1963 - 1967 is representative of this industry. Growth is calculated by the relationship

$$\frac{1967-1963}{4} = \frac{2.5\times10^6 - 2.3\times10^6}{4} = \frac{5\times10^4}{YR}\ \text{TONS/YR}$$

Extrapolating the above data (considering fish prod as negligible) we may estimate the 1975 production of smoked meat Note! simple growth assumed.

$$P_{75} = 2.9\times10^6 \text{ TONS/Year}$$

Smoked Fish & Meat Production



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Computation Sheet For Industrial Factors

Calculations Done By W. Moanore Date 9-17-74

Source Smoked Meats

P_c: cont'd

The simple growth based on the base-year of 1975 is represented by:

$$P_c = \frac{5 \times 10^4}{2.9 \times 10^6} = .017 \text{ simple}$$

$$\boxed{P_c = .017 \text{ simple}}$$

A:

The production capacity is calculated from the 1975 production estimate and the value of K = .81

$$A = \frac{P_{75}}{K} = \frac{2.9 \times 10^6}{.81} = 3.58 \times 10^6$$

$$\boxed{A = 3.6 \times 10^6 \text{ Tons/yr smoked meat}}$$

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Computation Sheet For Industrial Factors

Calculations Done By W. Marrone Date 9-17-74

Source Smoked Meat

P_B :

Ref 037 pg 31 Section 20.4

Meat smoking is assumed to be covered under the general category in the IRS table of asset guidelines

Asset guideline = 12 yrs

P_B est by 2 × IRS = 24 yrs

100% dep in 24 yrs ⟹ $\frac{100\%}{24\,yr}$ = 4.1 %/yr simple

We will approximate this as 4%/yr

∴ P_B = .04 simple

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Computation Sheet For Emission Factors

Calculations Done By W. Marrone Date 9-17-74

Source Smoked Meat

Ref 075 Table 6.7-1

E_u & E_N

Pollutant	E_u lb/ton meat	E_N lb/ton meat
Particulate	.3	.1
CO	.6	0
HC { CH_4 aldehydes org. acids	.35	.15

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Computation Sheet For: Emission Factors

Calculations Done By W. [illegible] Date 10-1[illegible]

Source Smoked Meat

E_s 1 CO and Hydrocarbons

There are no regulations for CO or HC which may be applied to meat smokehouses so that we assume $E_s = E_u$

$$E_{s\ CO} = .6\ \text{lb/ton meat}$$

$$E_{s\ HC} = .35\ \text{lb/ton meat}$$

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Computation Sheet for Emission Factors

Calculations Done By D. Marrone Date 10-29-79

Source Smoked Meat

E_s 1 Particulate

Figures detailing the number or distribution of meat smoking plants in the U.S. are not available. Ref. 004 Figure 2, pg. 14 shows the state-wide % breakdown of meat smoking production. From Ref. 158 we know the total number of plants in the Industry SIC code 2013 (Sausages & other prepared meats) for 1972 was 1,297. 550 of these establishments employ 20 or more people. For the purpose of estimation we first assume that all of these latter plants smoke meat.

From the production curve attached

$$P_{72} = 2.75 \times 10^6 \text{ T/yr} \Rightarrow Cap_{72} = \frac{P_{72}}{.81}$$

$$Cap_{72} = \frac{2.75}{.81} \times 10^6 \text{ T/yr} \approx 3.4 \times 10^6 \text{ T/yr}$$

smoked meat

Typical Meat Smoking Annual Capacity

$$\frac{3.4 \times 10^6 \text{ T/yr}}{550} = 6.18 \times 10^3 \text{ T/yr per plant}$$

We assume an operating schedule of $8 \frac{hr}{d} \times 365 \frac{d}{yr} = 2920 \frac{hr}{yr}$

Typical Plant Meat Smoking Hourly Capacity Rate

$$6.18 \times 10^3 \frac{T}{yr} \times \frac{yr}{2920 \text{ hr}} \times \frac{2000 \text{ lb}}{T} = 4,233 \text{ lb/hr smoked meat}$$

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Computation Sheet For Emission Factors

Calculations Done By W. Marrone Date 11-29-74

Source Smoked Meat

E_5 1 Particulate cont'd

Ref 075 Table 6.7-1 pg 6.7-1

"Emissions from smokehouses are generated from the burning hardwood rather than from the cooked product itself".

Emission factors are provided on the basis of $\frac{110 \text{ lb meat smoked}}{\text{lb wood burned}}$

It is a matter of interpretation of which components be included in the process weight rate (wood + meat or wood only)

Calculating an allowable emission based on wood only and the 50 state Average Process Weight Table we obtain

$$4{,}233 \frac{\text{lb meat}}{\text{hr}} \times \frac{\text{lb wood}}{110 \text{ lb meat}} = 38.5 \text{ lb wood/hr}$$

$$\text{Allowable Emission} \cong .01 \text{ lb P/hr}$$

and;

$$\frac{.01 \frac{\text{lb P}}{\text{hr}} \times 2000 \frac{\text{lb}}{\text{Ton}}}{4{,}233 \frac{\text{lb meat}}{\text{hr}}} \cong .005 \text{ lb P/Ton meat}$$

This value is a factor of 20 lower than the estimated value of E_M.

We make the assumption that the true interpretation would in fact include the weight of the meat and the wood.

$$\therefore \text{Process Rate} = \underset{\text{meat}}{4{,}233 \frac{\text{lb}}{\text{hr}}} + \underset{\text{wood}}{38.5 \frac{\text{lb}}{\text{hr}}}$$

$$\text{Process Rate} \cong 4272 \text{ lb/hr}$$

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Computation Sheet For Emission Factors

Calculations Done By JJ Marrone Date 10-29-74

Source Smoked Meat

E_s: Particulate cont'd

From the 50 state average process Table we obtain an allowable emission of 7 lb/hr

and,

$$E_s = \frac{7 \frac{\text{lb pt}}{\text{hr}}}{4,233 \frac{\text{lb meat}}{\text{hr}} \times \frac{\text{Ton}}{2000\ \text{lb}}} \approx 3.31\ \text{lbs/ton meat smoked}$$

Since $E_s > E_{14}$ (E_{14} = .3 lb/ton sm meat)
we conclude that these plants would necessarily comply with state regulations based on a general process weight rate table using the meat & wood input rate. $E_s = E_{14}$ for the model

$$\boxed{E_s = .3\ \text{lb/ton smoked meat}}$$

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Computation Sheet For Industrial Factors

Calculations Done By [illegible] Date 1/[illegible]/75

Source STARCH

Ref ([illegible]) p V-49 gives 1968 starch production @ 5.8×10^9 LBS.

Since no information could be located regarding growth, we will assume that, because of its high consumer use, growth parallels the population. See "Industrial Factors - Dry Cleaning"

$$\boxed{P_C = 0.018}$$ compound

No specific value of K could be obtained, so we will use that for the chemical industry in general. From Ref (144) p 48, the avg K for the chemical industry between 1965 & 1973 is 83%

$$\boxed{K = 0.83}$$

$$A = \frac{(5.8 \times 10^9)(1.018)^{11}}{(.83)(2000)} = 4.25 \times 10^6 \text{ tons}$$

$$\boxed{A = 4.25 \times 10^6 \text{ tons starch}}$$

From Ref (37) p 53 the allowable IRS guideline for "Manufacture of Chemicals and Allied Products" is 11 yrs

$$P_B = \frac{1}{2(11)} = 0.045$$

$$\boxed{P_B = 0.045}$$ simple

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Computation Sheet For Industrial Factors

Calculations Done By [illegible] Date [illegible]

Source Starch

Ref (95) p 6.11-1 Tab 6.11-1

$$\boxed{E_{UP} = 8.0 \ \text{lb}/\tfrac{\text{ton}}{\text{starch}}}$$

Also, $\boxed{E_{NP} = 0.02 \ \text{lb}/\tfrac{\text{ton}}{\text{starch}}}$ using a centrifugal gas scrubber

[illegible]

Ref (236) p V-89 states the capacity of a "large manufacturing plant" @ 18,200 lb/hr

We will assume a "typical" size of 15,000 lb/hr & use the gen'l PWR curve generated from Ref (48) & (182)

The allowable is 15.0 lb/hr

$$E_{SP} = \frac{15(2000)}{15{,}000} = 2.0$$

$$\boxed{E_{SP} = 2.0 \ \text{lb}/\tfrac{\text{ton}}{\text{starch}}}$$

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Computation Sheet For Industrial Factors

Calculations Done By W. Marrone Date 8-1-79

Source Bagasse Burning from Sugar Cane Processing

K1 Ref 003 pg 8-1

"mills in Fla and La have 10-15% unused capacity. Puerto Rico is believed to have somewhat more unused capacity and Hawaiian mills an unknown amount, but in each instance other factors limit the availability of cane for grinding."

We will assume as a conservative estimate that approximately 25% of the capacity is unused. This will take into account the other plants operating in La and Hawaii and the typical factors that normally limit production. (crop failure, crop variability, etc)

$$\boxed{K_1 = .75}$$

a better estimate may be found

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Computation Sheet For Industrial Factors

Calculations Done By D. Mossman Date 8-1-74

Source Bagasse Burning

A1 From Fig 2 pg 8-3 Ref 003 we obtain directly the estimated 1975 production of raw cane sugar

$$\text{raw cane sugar } P_{75} = 3.65 \times 10^6 \text{ Ton/yr}$$

Information supplied in Ref 093 pg 571-576 permits the determination of the quantity of cane necessary to produce the 1975 raw cane prod.

11-15% of cane is sucrose.
96% of sucrose juice is reclaimed

We will assume 15% sucrose in cane and 96% recovery

$$1975 \text{ cane} = \frac{1975 \text{ raw cane sugar}}{.15 \times .96}$$

$$= \frac{3.65 \times 10^6}{.15 \times .96}$$

$$1975 \text{ cane} = 25 \times 10^6 \text{ Ton/yr}$$

The fraction of bagasse from cane is reported to be 30% (Ref 003 p 2-3) and according to an estimate of 10% bagasse burned in reference 093 p 577 we may calculate the 1975 bagasse production rate.

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Computation Sheet For Industrial Factors

Calculations Done By W. Massone Date 8-1-74

Source Bagasse Burning

A: cont'd

using 1975 cane prod = 25×10^6 T/yr
% bagasse in cane = 30%
% bagasse burned = 70%

$$\text{bagasse } \underset{1975}{\text{burned}} = .70 \times .30 \times 25 \times 10^6 \text{ T/yr}$$
$$= 5.25 \times 10^6 \text{ T/yr}$$

Using the value of K = .75 we calculate the 1975 production capacity.

$$A = \frac{5.25 \times 10^6}{.75}$$

$$\boxed{A = 7 \times 10^6 \text{ T/yr bagasse burned}}$$

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Computation Sheet For Industrial Factors

Calculations Done By W. Masser Date 8-1-74

Source Bagasse Burning

P_c 1

Growth rate in the raw sugar cane industry will approximately mirror the growth in bagasse burning. This of course assumes that the use of bagasse for fuel in process boilers remains attractive. This may not be true in light of environmental regs and control costs. Rising fuel costs and uncertain availability may encourage bagasse burning, on the other hand.

From Fig 2 p 8-3 Ref 003
the simple growth for the period 1975 to 1985 is assumed to be identical with the slope of the total domestic raw sugar cane production estimated for 1970 - 1980

$$\text{slope} = \frac{\overset{1980}{3.99} - \overset{1970}{3.44}}{10} = .055 \times 10^6 \ \frac{T/yr}{yr}$$

$$P_c = \frac{.055 \times 10^6}{\underset{\substack{\uparrow \\ 1975 \text{ prod}}}{3.65 \times 10^6}} = .015 \text{ simple}$$

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Project Number - 32391 New Source Performance Standards

Computation Sheet For Industrial Factors

Calculations Done By [illegible] Date 9-23-74

Source Bagasse Burning (Sugar Processing)

P_B : Ref. C37 pg 121-124 identifies water-tube boilers in bagasse burning. Small boiler and larger boilers are depicted as 40,000 lb/hr steam and 370,000 lb/hr steam respectively. This puts them in the class of #1 watertube according to the Table in "Fossil Fuel Boilers" Industrial Factors

The P_B determined for this boiler type was 5% simple

Also considering bagasse boilers to be comparable to medium size industrial boiler ($10 - 250 \times 10^6$ BTU/hr) we would obtain a P_B of 5.0% simple according to the summary table of "Fossil Fuel Boiler" - Industrial Factors

$$\boxed{P_B = .05 \text{ simple}}$$

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Computation Sheet For Industrial Factors

Calculations Done By W. Marrone Date 8-1-74

Source Bagasse Burning

Sugar Cane Processing: Ref 003

1970 DATA 11 × 10^6 ton refined sugar ← 11.9 × 10^6 tons raw sugar

← 30% domestic sugar beet
← 29% domestic sugar cane
← 41% overseas sources

Bagasse is usually burned at raw sugar cane mills to eliminate solid wastes and provide process steam

Particulate emissions are due to: (a) low heat value
(b) fibrous nature of bagasse
(c) substantial moisture

30% of raw cane entering the mill may end up as bagasse. There have been some, although limited, ventures of using bagasse for paper or livestock bedding, etc.

* 10% of bagasse is normally used as fuel to boilers with auxiliary fuel like gas or oil Ref – 073 p577

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Computation Sheet for Emission Factors

Calculations Done By D. Marrone Date 8-1-74

Source Bagasse Burning

Particulate

E_u: Ref 075 p 6.12-1 Table 6.12-1

E_u = 22 lb/ton of bagasse

E_N: According to control info in Ref 003 pg 4-1 to 4-2 the most modern mills presently use small dia mechanical collectors (multiclones) which when operating properly yield efficiencies of 60-75%.

Development of other more effective systems has not proven out. This has been explained due to the erosive and excessive fly ash content of the exhaust stream.

Pilot tests have been performed Ref 003 pg 4-3 on several mills with two control devices in series the first device being a multiclone and the second either a venturi or cyclonic wet scrubber. Results have shown 90-99% eff.

Even though the above reference indicates problems of a mechanical nature with piloted control system and waste disposal difficulties we will assume these will be worked out and giving the best [illegible] of attainable control efficiency we will consider 90% to be within 1975-1985 technology

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Computation Sheet For Emission Factors

Calculations Done By D. Massena Date 8-1-74

Source Bagasse Burning

Particulate

E_M; cont'd

therefore; $E_M = .10 \times E_U$ where $E_U = 22$ lb/T

$$\boxed{E_M = 2.2 \text{ lb/Ton of bagasse burned}}$$

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Computation Sheet For Emission Factors

Calculations Done By W. Massena Date 8-1-74

Source Bagasse Burning

Predominant location of Sugar Cane Mills : Ref 003

Mfg Data

① Florida 4-6 months/yr
② Hawaii year round
③ Louisiana few months/yr
④ Puerto Rico 4-5 months/yr
⑤ Texas ?

Florida 9 sugar cane mills around W. Palm Beach

Louisiana 48 sugar cane mills south central La.

Texas 1973-74 1st year of operation quota 100,000 T/yr sugar

Hawaii 25 sugar cane mills 4 main islands

Puerto Rico 15 sugar cane mills (industry declining in recent years)

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Computation Sheet for Emission Factors

Calculations Done By W. Marrone Date 10-17-74

Source Bagasse Burning

III_b | Particulate

Ref 038 Table 43 and Table 42 (pg 130) were used to obtain a typical size plant.

T/hr	Distribution
2.4-10	25%
10.1-20	62.5%
20.1-28.7	12.5%

The above distribution for Florida is assumed applicable industry-wide. We take the average burning rate in the three ranges and weight by the % distribution to obtain a typical plant size

.625(15) + .25(6.2) + .125 (24.4)

9.375 + 1.55 + 3.05

Typical Plant = 14 T/hr bagasse burning rate

Ref 038 pg 135 Heating value of Bagasse 3,600 BTU/lb

pg 135 Supplemental fuel in 1972 Florida season was "Bunker C" @ 1.05 gal/ton bagasse which we assume typical of industry

BTU/Gal for 'C' or No 6 ref 101 Table 9.9 pg 9-6

BTU/Gal 150,700 - 152,000 Avg = 151,350

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Computation Sheet for Emission Factors

Calculations Done By W. Marrone Date 10-17-74

Source Bagasse Burning

V5: Particulate

We will calculate the heat input for the typical bagasse boiler burning 14 T/hr bagasse and supplementary fuel (oil)

$$H.I. = 14 \frac{T}{hr} \times \frac{2000\ lb}{ton} \times 3{,}600 \frac{BTU}{lb} + 1.05 \frac{gal}{ton} \times 14 \frac{ton}{hr} \times 151{,}000 \frac{BTU}{gal}$$

$$H.I. = \left(1.008 \times 10^8\right) + \left(2.22 \times 10^6\right) \frac{BTU}{hr}$$

or $$H.I. \cong 1.03 \times 10^8$$

$$H.I. \cong 103 \times 10^6 \frac{BTU}{hr}$$

Oil Fuel supplement contribute $\frac{2.22 \times 10^6}{103 \times 10^6} \times 100 = 2.2\%$ of heat input

Since the majority of the heat input is attributable to the bagasse we will compare emissions with the regulations in suitable states for solid fuels

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Computation Sheet for Emission Factors

Calculations Done By W. Marevore Date 10-17-74

Source Bagasse Burning

E_5 1 Particulate Ref. 148

States	Regulations
Puerto Rico	.30 lb / 10^6 BTU heat input
Texas	.3 lb / 10^6 BTU heat input
Florida	.3 lb / 10^6 BTU Existing .2 lb / 10^6 BTU New
Louisiana	.6 lb / 10^6 BTU
Hawaii	.4 lb / 100 lb bagasse burned

use average ⇒ .25 lb/10^6 BTU

Converting the lb/10^6 BTU figures into lb/Ton of bagasse burned and (lb/100 lb)

$$\frac{\text{lb PT}}{10^6\ \text{BTU}} \times \frac{10^6\ \text{BTU/HR}}{\text{TON/HR}} = \text{lb PT/TON Bagasse}$$

$$\frac{\text{lb PT}}{100\ \text{lb}} \times \frac{2000\ \text{lb}}{\text{TON}} = \text{lb PT/TON Bagasse}$$

Puerto Rico .3 × $\frac{103}{14}$ = 2.2 lb/ton
Texas .3 × $\frac{103}{14}$ = 2.2 lb/ton
Florida .25 × $\frac{103}{14}$ = 1.8 lb/ton
Louisiana .6 × $\frac{103}{14}$ = 4.4 lb/ton
Hawaii .4 × 2000/100 = 8.0 lb/ton

Avg = $\frac{\Sigma}{5}$ = $\frac{18.6}{5}$

Avg = 3.7 $\frac{\text{lb}}{\text{TON}}$

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Computation Sheet For Emission Factors

Calculations Done By W. Marrone Date 10-17-74

Source Bagasse Burning

E_5 Particulate cont'd

$$\boxed{E_5 = 3.7 \text{ lb}/\text{Ton of Bagasse}}$$

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Computation Sheet For Industrial Factors

Calculations Done By W. Marrone Date 9-17-79

Source Field Burning (Sugar Cane Processing)

K1 Emission Factors are presented in terms of acres burned. By this basis $K_1 = 1$ however, it is not interpreted directly as utilization of capacity

$$\boxed{K_1 = 1}$$

P_c: The growth rate for sugar cane field burning is assumed identical to the rate determined for bagasse burning. Both these operations are directly related to sugar cane production. The 1970-1980 est simple growth was determined to be 15% which we apply to 1975-1985 period

$$\boxed{P_c = .015 \text{ simple}}$$

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Computation Sheet For Industrial Factors

Calculations Done By W. Marrone Date 9-17-74 & 9-23-74

Source Field Burning (Sugar Cane)

A :

The following yield info was obtained from the Dept of Agriculture;

2.93 Tons sugar per acre of sugar cane
Telecom 9-23-74 Sugar Div Dept of Agr

Year	Tons Sugar Cane / acre
1971	38.1
1972	41.0
1973	35.4

Avg = 38.2 Tons/acre

From Industrial Factors on "Bagasse Burning" under the development of A (1975 production capacity) we obtained the 1975 cane yield est of 25×10^6 tons cane

We may ~~now~~ estimate the 1975 sugar cane acreage necessary to support this cane based on the above value of 38.2 tons/acre (most amenable to our calculation procedure)

$$\frac{25\times10^{6} \text{ tons cane}}{38.2 \text{ tons cane/acre}} = .65\times10^{6} \text{ acres}$$

This acreage is assumed burned in 1975 after producing 25×10^6 tons of cane which ultimately produced 3.69×10^6 tons of raw cane sugar (see Bagasse Burning)

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Computation Sheet For Industrial Factors

Calculations Done By D. Marrone Date 9-21-74

Source Field Burning (Sugar Cane Processing)

A: cont'd

The 1975 sugar cane acreage estimated to being burned is about 650,000 acres with $K_1 = 1$

$$\boxed{A = .65 \times 10^6 \text{ acres burned}}$$

P_B: Replacement of obsolescent capacity is not amenable to field burning so we represent P_B by zero

$$\boxed{P_B = 0}$$

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Computation Sheet for Emission Factors

Calculations Done By W. Marrone Date 9-17-74

Source Field Burning (Sugar Cane)

E_u: Ref 075 Table 6.12-1

Pollutant	lb/acre burned
Particulate	225
CO	1,500
HC	300
NO_x	30

The waste burned consists of 4 tons/acre is cane foliage and 11 tons/acre grass and weeds. (15 tons/acre)

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Computation Sheet For Emission Factors

Calculations Done By William Massara Date 10-13-74

Source Field Burning (Sugar Cane)

E_N:

The greatest impact of controls on sugar cane field burning would result from measures aimed at eliminating this practice. We will assume that field burning will not be permitted to assess the greatest impact of control legislation (NSPS). Practice will be replaced

E_N in terms of lb/acre burned

or lb/ton raw sugar cane

E_N part = 0 lb/acre burned
HC = 0
CO = 0
NO_x = 0

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Computation Sheet for Emission Factors

Calculations Done by W. Messina Date 10-17-77

Source Field Burning (Sugar Cane Processing)

E_s: Ref. V19

A survey of the SIP's for Florida, Hawaii, Louisiana, Puerto Rico and Texas showed that in the area of open burning the following rules apply:

Puerto Rico	Open burning prohibited however approval may be obtained
Hawaii	Agricultural burning allowed with permission & guidelines
Texas	" " " " " " "
Louisiana	" " " " " " "
Florida	" " " " " " "

None of these sugar cane producing states make a specific prohibition against agricultural burning and in fact it appears that in all cases permission will be obtained as long as guideline procedures are followed during burning.

We therefore assume that there are no regulations affecting this industry and $E_s = E_u$

E_s part = 225 lb/acre
E_s CO = 1,500 lb/acre
E_s HC = 300 lb/acre
E_s NO_x = 30 lb/acre

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Project Number # 32391 New Source Performance Standards

Computation Sheet for Industrial Factors

Calculations Done By [illegible] Date 1-3-78

Source Vegetable Oil Production

There are a variety of seeds that find their way into vegetable oil production and among the most noteworthy are;

(1) soybean
(2) cotton seed
(3) peanut
(4) flax (linseed)

Process operations may differ from seed to seed however the general process steps are similar (Ref. [illegible] pg 1 to 3-16)

Ref 008 pg 1-2 Table 1 shows the production for the various vegetable oils. I see that soybean and cotton seed represents a significant part of the total.

$$\begin{array}{r} 8500 \\ +\underline{1100} \\ 9600 \end{array}$$

TOTAL = 10700

cottonseed
soybean $\left\{ \dfrac{9600}{10700} = 90\% \right.$ of total production

We will describe this industry by looking at total vegetable oil production rather than breaking it down into specific products. Factors may be developed; however it is understood that they apply in general and may not be true in particular cases:

(1) While overall results is presented, individual results may be higher, or lower.

(2) emissions may vary widely due to differences in process operations

etc.

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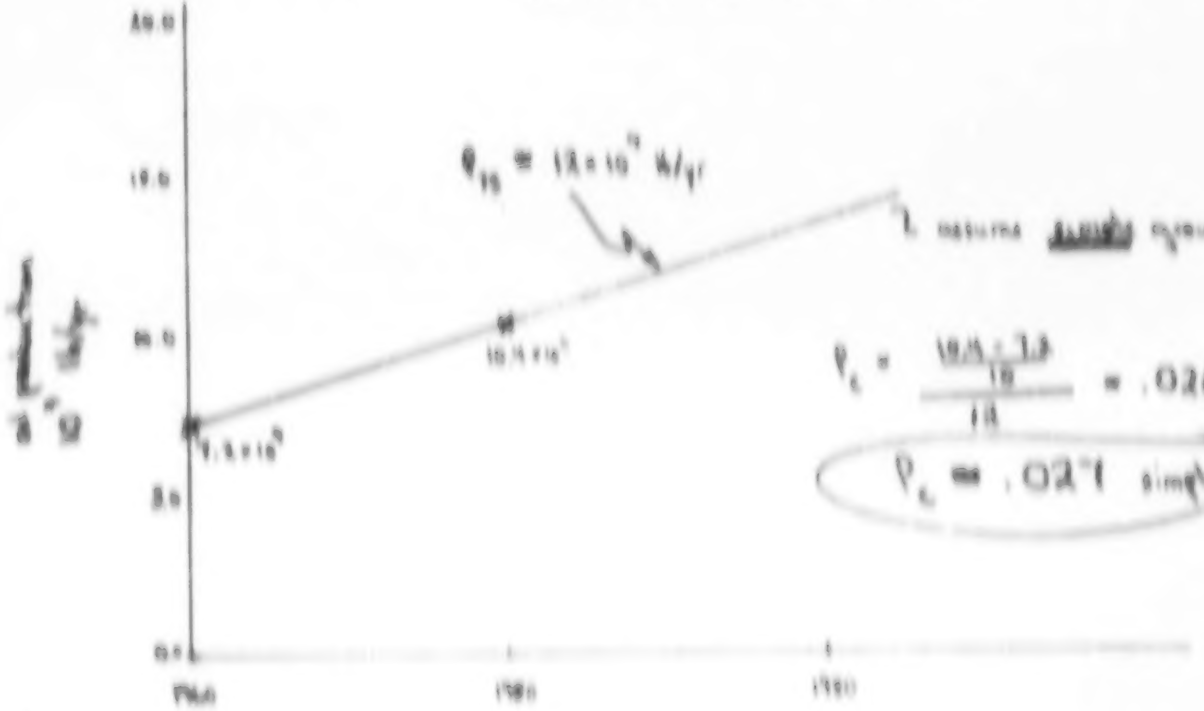
Computation Sheet For Industrial Factors

Calculations Done By D. Massoni Date 1-2-75

Source Vegetable Oil Production

P_c:

Ref 002 pg 1-1 Production for 1960 and 1970



$P_c = \dfrac{\frac{10.4-7.3}{10}}{[illegible]} = .0265$

$\boxed{P_c \cong .027 \text{ simple}}$

K:

Ref 002 p 8-2

states that oil seed production (input) is not expected
to be much below oil process capacity
This implies a value of K near unity!!

From Ref 247 p 138 1970 capacity, 825×10^6 bushels soybean
and from Table 48 pg 137 1970 production 761,868×10^3 bushels

$K_{70} = \dfrac{761,868}{825} = .923$

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Computation Sheet For Industrial Factors

Calculations Done By W. Massone Date 1-2-75

Source Vegetable Oil Production

K_1 cont'd

We will assume that a value of .92 is representative for all vegetable oil processing plants

$$\boxed{K_1 = .92}$$

A: Using the 1975 Production value of 12×10^9 lb/yr obtained above and $K_1 = .92$ we may calculate the 1975 Production Capacity

$$A = \frac{12 \times 10^9 \ \frac{\text{lb}}{\text{yr}} \times \frac{\text{ton}}{2000 \text{ lb}}}{.92} = 6.52 \times 10^6 \text{ ton/yr}$$

$$\boxed{A = 6.52 \times 10^6 \ \frac{\text{ton}}{\text{yr}} \quad \text{vegetable oil produced}}$$

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Project Number - 32J91 New Source Performance Standards

Computation Sheet For Industrial Factors

Calculations Done By DJ Massone Date 1-2-75

Source Vegetable Oil Production

P_B :

Ref 087 Class 20.8

Asset Guideline Period = 18 yrs
P_B est → 2×ADR = 36 yrs

$$\frac{100\%}{36 \text{ yrs}} = 2.77\,\%/\text{yr} \text{ simple}$$

$$\boxed{P_B = .028 \text{ simple}}$$

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Project Number - 32391 New Source Performance Standards

Computation Sheet for Emission Factors

Calculations Done By RJ. Masserna Date 1-2-75

Source Vegetable Oil Production

Ref 002 pg 2-3 about two-thirds (67%) of the oil mills in the US use solvent extraction directly or in combination with mechanical pressing

since this operation is the only source of HC we will develop an "emission factor (EF)" for the industry which will reflect this 67% process usage and the highest process emissions

Particulate emissions occur in various seed and meal handling and process steps. Operations are known to vary from seed to seed, mill to mill. There was no great body of emission data for particulate emissions from this industry. Data for soybean process was obtained (Ref 247) and will be applied to the industry. This will be adequate since soybean processing incorporates most of the processing steps in vegetable oil prod. and it accounts for 80% of the total vegetable oil production and therefore will be more than typical of the industry.

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Computation Sheet for Emission Factors

Calculations Done By W. Massone Date 1-2-75

Source Vegetable Oil Production

Hydrocarbons

E_H Ref 002 pg 2-13

Modern plants are identified as emitting ½ gal or less (hexane) per ton of seed processed

From Ref 217 p 103 60 lb soybean seed → 11 lb oil

$$\text{soybean} \left\{ \frac{11 \text{ lb oil}}{60 \text{ lb seed}} \times 2000 \frac{\text{lb}}{\text{ton}} = 366 \frac{\text{lb oil}}{\text{ton seed}} \right.$$

and p 117

$1,211 \times 10^9$ lb oil prod
$3,728 \times 10^6$ tons seeds crushed } cotton seed

$$\frac{1,211 \times 10^9}{3,728 \times 10^6} = 325 \frac{\text{lb oil}}{\text{ton seed}}$$

These two oil represent ≈ 90% of the total production with 80% of total from soybean alone

$$W_{avg} = .8(366) + .1(325) + .1(W_{avg})$$

$$.9W_{avg} = 292.8 + 32.5 = 325.3$$

$$W_{avg} = 361 \text{ lb oil/ton seed}$$

Therefore using ½ gal emitted (hexane) per ton seed as the aggregate conversion we may calculate the value of E_H in terms of lb/ton oil produced

Ref 105 p 1??
hexane sp gr = .659
$.659 \times 8.337 = 5.49 \text{ lb/gal}$

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Computation Sheet For Emission Factors

Calculations Done By W. Massone Date 1-2-75

Source Vegetable Oil Production

Hydrocarbon cont'd

E_N: $.5 \frac{\text{gal HC}}{\text{TON seeds}} \times 5.44 \frac{\text{lb HC}}{\text{Gal}} \quad \frac{\text{TON seeds}}{361 \text{ lb oil}} \times 2000 \frac{\text{lb}}{\text{TON}} = 15.2 \text{ lb/TON oil}$

$$\boxed{E_N = 15.2 \text{ lb/TON vegetable oil produced}}$$

E_U: Ref. 002 pg 2-13

while giving a figure of .5 gal/ton seed for modern plants it states that other less efficient plants emit 1 to 1½ gal per ton.

We assume that the typical plant will emit 1.25 Gal/TON seed which is 1.25/.5 = 2.5 times greater than the emission used in determining E_N

$E_U = 2.5 \times E_N = 2.5 \times 15.2 = 38 \text{ lb/TON oil}$

$$\boxed{E_U = 38 \text{ lb/TON vegetable oil produced}}$$

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Computation Sheet For Emission Factors

Calculations Done By W. Marrone Date 1-2-75

Source Vegetable Oil Production

Hydrocarbons cont'd

E_s:

Typical plant size for this industry was not obtained however by looking at soybean we may get a good feel for representative sizes.

Ref 247 @ 191 1970 150 mills
825 × 10^6 bushel capacity (seeds) (60 lb seed/bushel)

$$825 \times 10^6 \frac{\text{bushel}}{\text{yr}} \times 60 \frac{\text{lb seed}}{\text{bushel}} = 49.5 \times 10^9 \frac{\text{lb}}{\text{yr}} \text{ seed (bushel)}$$

using 150 mills and 350 d/yr operation

$$\text{Average Plant Size} = \frac{49.5 \times 10^9 \frac{\text{lb}}{\text{yr}} \times \frac{\text{yr}}{350\ \text{d}} \times \frac{\text{ton}}{2000\ \text{lb}}}{150\ \text{mills}} = 544 \frac{\text{tons}}{\text{d}} \text{ seed input capacity}$$

this also represents

$$544 \frac{\text{tons seed}}{\text{day}} \times 361 \frac{\text{lb oil}}{\text{ton seed}} \times \frac{\text{ton}}{2000\ \text{lb}}$$

$$98 \frac{\text{tons}}{\text{day}} \text{ oil production capacity}$$

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Computation Sheet for Emission Factors

Calculations Done By RJ Marrone Date 1-2-75

Source Vegetable Oil Production

Hydrocarbons cont'd

E_u: an uncontrolled average plant emits : $38 \frac{lb}{ton\ oil} \times 98 \frac{ton\ oil}{day} = 3724 \frac{lb}{day}$

Making the interpretation that hexane is non-reactive we may review Ref. 081 of 118 to determine a value for E_s

Ref. 082 Appendix gives location of most vegetable oil plants by state

31 states have vegetable oil plants. Of these 31 states only one (Kentucky) has a regulation applicable to non-reactive solvents [3000 lb/day]. All other states are therefore assumed to permit E_u for non-reactive solvents.

Kentucky 3 plants E_{s_1} = 3000 lb/day limit
U.S. Total 246 plants $E_{s_2} = E_u$ = 3724 lb/day

$$E_s' = \frac{3}{246}(3000) + \frac{243}{246}(3724) = 3715\ lb/day$$

and using $98 \frac{ton\ oil}{day}$; $E_s = \frac{3715\ lb/day}{98\ ton/day} = 37.9 \frac{lb}{ton\ oil}$

$$\therefore E_s = 37.9\ lb/ton\ \text{vegetable oil produced}$$

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Computation Sheet For Emission Factors

Calculations Done By W. Marrone Date 1-8-75

Source Vegetable Oil Production

Particulate

Emission factors were not found in the literature however limited data was obtained in Ref #47 Appendix G for emission from various soybean processing operations.

We will assume that an emission factor derived from the data may be applied to the whole vegetable oil industry especially since soybean oil represents 80% of the industry.

The data in Ref #47 App G gives emissions in terms of lb part/ton seed processed or lb part/bushel for the various process after specified control devices (apparently cyclones). Control efficiency was not reported. We will synthesize an emission factor for the sum of the operations and assume an efficiency of 85% overall as probable for the plants tested in order to arrive at a value of E_u.

The following emission factors are used [Ref pg 2 Emission Factor: this industry]

(i) 11 lb pt/bushel

(ii) 361 lb pt/ton seeds

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Computation Sheet For Emission Factors

Calculations Done By D. Mascone Date 1-8-78

Source Vegetable Oil Production

Particulate contd Ref. 247 App G Table G-2 & G-3

E_u:

Operation	Controlled Emission Factor Reported		Converted lb/ton oil
Hull handler	.0025	lb/bu	.455
Flake Roll Aspir	.0038	lb/bu	.691
Primary Dehulling	.0095	lb/bu	1.727
Hull Screen & Conveyor	.00065	lb/bu	.115
Meal Cooler	.0056	lb/bu	1.019
Meal Dryer	.00031	lb/bu	.056
White Flake Cooling	.95	lb/ton seed	5.263
Forebay Screens	.021	lb/ton seed	.116
			9.441

$$E' = 9.44 \text{ lb/ton oil}$$

This factor is believed to cover most emission sources from vegetable oil processing. Applying the assumed overall efficiency (85%) to the controlled factor above, we may estimate E_u:

$$E_u = \frac{9.44}{1-.85} = 63 \text{ lb/ton}$$

$$\boxed{E_u = 63 \text{ lb/ton vegetable oil produced}}$$

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Project Number 32341 New Source Performance Standards

Computation Sheet For: Emission Factors

Calculations Done By: A. Marquette   Date: 1-3-78

Source: Vegetable Oil Production

Particulate contd

E_u :

Ref 249 Table 55 pg 157

The application of fabric filter, cyclone, and wet scrubber controls to various soybean processing operations achieves efficiencies as high as 99% or better. We assume that a level of 99% is achievable throughout the vegetable oil industry.

$\therefore E_c = .01 \times E_u = .01 \times 68 = .68$ lb/ton

$$\boxed{E_c = .68 \text{ lb/ton veget oil produced}}$$

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Project Number - 32391   New Source Performance Standards

Computation Sheet for   Emission Factors

Calculations Done By R.J. Marzano   Date 1-3-78

Source Vegetable Oil Production

Particulate cont'd

From p. 4 of "Emission Factors" (AP) for this industry we see that the average plant size is about

544 ton/day seed input or 98 ton/day oil production

assuming 24 hr/day then, Average Size = 22.7 ton/hr seed input

= 4.1 ton/hr oil production

Process Weight Rate 22.7 T/hr or 45,400 lb/hr

Ref. 002 Appendix   gives the distribution of vegetable oil processing plants such that we may tally the number per state. 31 states are shown to have processing mills. For the list presented there are 246 plants

We will determine an allowable emission (E_{si}) for each state from the process weight table [Ref. 004 + 118] using a process weight rate of 45,400 lb/hr input and then synthesize a E_g by weighting each state E_{si} by the fraction of the total mills in that state.

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Computation Sheet for Emission Factors

Calculations Done by JJ Massaro Date 1-3-75

Source Vegetable Oil Production

Particulate cont'd

E_s =

State	No. Plants	A_i	E_{si} lb/hr Allowable	$E_{si} \times A_i$
Alabama	9	.0366	24.0	.8784
Arizona	4	.0163	33.0	.5379
Arkansas	15	.0610	24.0	1.4640
California	20	.0813	31.5†	2.5610
Delaware	1	.0040	*	.0040 × $E_{si\,avg}$
Florida	1	.0040	24.0	.0960
Georgia	12	.0488	33.0	1.6104
Illinois	27	.1098	33.0	3.6234
Indiana	4	.0162	33.0	.5346
Iowa	14	.0569	33.0	1.8777
Kansas	3	.0122	33.0	.4026
Kentucky	3	.0122	33.0	.4026
Louisiana	10	.0406	33.0	1.3398
Maryland	1	.0040	31.5	.1260
Mass	1	.0040	31.5	.1260
Mich	4	.0162	33.0	.5346
Minn	20	.0813	33.0	2.6829
Mo.	7	.0284	33.0	.9372
Neb	2	.0081	24.0	.1944
N.J.	3	.0122	30.0	.3660
N.M.	3	.0122	31.5	.3843
N.Y.	4	.0162	29.0	.4698
N.C.	8	.0325	33.0	1.0725
Ohio	5	.0203	33.0	.6699
Okla	3	.0122	33.0	.4026
Penn	1	.0040	*	.0040 × $E_{si\,avg}$
R.I.	1	.0040	33.0	.1320
S.C.	11	.0447	33.0	1.4751
Tenn	10	.0406	24.5	.9947
Tex	35	.1423	64.0	9.1072
Vir	4	.0162	33.0	.5346
TOTAL	246			

* none regulation, assume $E_{si} = E_{si\,avg}$

† Ref's 156 pg 33

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Project Number: 3719 New Source Performance Standards

Calculation Sheet for: Emission Factors

Calculation Done by: M. Marrone Date 1-7-75

Source: Vegetable Oil Production

Particulate cont'd

E_s

$$E_{s_{in}} = .008\,E_{s_{in}} + \sum E_i A_i$$

$$E_{s_{in}} = .008\,E_{s_{in}} + 35.115$$

$$.992\,E_{s_{in}} = 35.115$$

$$E_{s_{in}} \approx 35.4 \text{ lb/hr}$$

With: 4.1 $\frac{\text{tons oil}}{\text{hr}}$ per eq

$$E_s = \frac{35.4 \text{ lb part/hr}}{4.1 \frac{\text{tons oil}}{\text{hr}}} = 8.63 \text{ lb/ton of vegetable oil produced}$$

$$\boxed{E_s = 8.63 \text{ lb/ton vegetable oil produced}}$$

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Project Number - 32391 New Source Performance Standards

Computation Sheet for Industrial Factors

Calculations Done By [illegible] Date 1/31/75

Source Whiskey

Ref ⑱ p 1-5

1970 Production = 917.5×10^6 gallons

From p 8-2 "The distilled spirits industry is currently operating near capacity...."

Assume, therefore

$$\boxed{K = 0.95}$$

From: Ref ⑱ p 8-3

$$\boxed{P_c = 0.06}$$ assume simple

$$A = \left(\frac{917.5 \times 10^6}{.95}\right)\left[1 + (5)(.07)\right] = 1303.8 \times 10^6 \text{ gallons}$$

$$\boxed{A = 1.304 \times 10^6 \text{ thousand gallons}}$$

Ref ⑱ p 8-5 5 plant closings in 1969

The number of plants in 1969 (p 1-3) was 155. Assuming equal size

$$P_b = \frac{5}{155} = 0.032$$

$$\boxed{P_b = 0.032}$$ simple

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Project Number - 32391 New Source Performance Standards

Computation Sheet For Emission Factors

Calculations Done By Hoppe Date 1/30/85

Source Whiskey

Hydrocarbons

Ref (118) p61 gives a total HC emission factor of 183 grams/m³ of grain. Using the following conversion factors, we can get lb/1000 gals

5.14 gallons/bushel grain (Ref 118 p57)
28.378 bu/m³
454 grams/lb

$$\frac{\left(183\ \frac{\text{grams HC}}{\text{m}^3}\right)\left(1000\ \text{gals}\right)}{\left(28.378\ \frac{\text{bu}}{\text{m}^3}\right)\left(\frac{454\ \text{gms}}{\text{lb HC}}\right)\left(5.14\ \frac{\text{gals}}{\text{bu}}\right)} = 2.76\ \text{lb}/1000\ \text{gals}$$

$$\boxed{E_{U_{HC}} = 2.76\ \text{lb}/1000\ \text{gals}}$$

No controls are used, however a carbon adsorption unit appears to be feasible. Assuming an $\eta = 98\%$

$$E_{N_{HC}} = (1-.98)(2.76) = 0.0552$$

$$\boxed{E_{N_{HC}} = 0.055\ \text{lb}/1000\ \text{gals}}$$

Since there are no applicable regs, $E_S = E_U$

$$\boxed{E_{S_{HC}} = 2.76\ \text{lb}/1000\ \text{gals}}$$

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Project Number - 32391 New Source Performance Standards

Computation Sheet For Emission Factors

Calculations Done By [illegible] Date 1/31/78

Source Whiskey

Particulate

Ref (15) p 6.5-2 Tab 6.5-1

$E_{up} = (3+5)$ lb/ton grain (Handling & drying)

Converting

$$\frac{\left(8\ \frac{lb\ P}{ton\ gr}\right)\left(56\ \frac{lb\ grain}{bu}\right)\left(1000\ gals\right)}{\left(2000\ \frac{lb\ grain}{ton\ grain}\right)\left(5.14\ \frac{gal}{bu}\right)} = 43.6\ lb/1000\ gals$$

$$\boxed{E_{up} = 43.6\ lb/1000\ gallons}$$

From Ref (18) p 4-5 Cyclone separators & baghouses have been installed as applicable control systems for whiskey [illegible] p 4-5

$\eta_{cyclone} \approx 90\%$

$\eta_{baghouse} \approx 95\%$

Assuming that 95% is attainable [illegible] baghouses

$E_{cp} = (1-.95)(43.6) = 2.18$ lb/1000 gals

$$\boxed{E_{cp} = 2.18\ lb/1000\ gals}$$

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Computation Sheet For Emission Factors

Calculations Done By [illegible] Date 1/31/75

Source Whiskey

From Ref ⑬ p 1-5

In 1970 917.5 x10⁶ gallons from 155 plants

From Ref (236) p V-25 Plants operate 24 hrs/day, 7 days/wk

$$\frac{917.5 \times 10^6}{(155)(8760)} = 675.7 \ \frac{gal}{hr \cdot plant}$$

$$\frac{\left(675.7 \ \frac{gal}{hr}\right)\left(56 \ \frac{lb}{bu}\right)}{5.14 \ \frac{gal}{bu}} = 7362 \ \frac{lb}{hr} \text{ grain handled}$$

This value is independent of the number of fermenters

Ref ⑬ p 1-5

$$\frac{94}{155} = 61\% \text{ of plants in Cal. \& Kentucky}$$

Using Ref (54), (148), (156) (LAAPCD) & the gen'l P.M. curve for the remaining 39% & Assuming Cal & Ky @ 30½% each

Allowable =

Cal = 8.38 lb/hr
Ky = 9.8 lb/hr
others = 10.0 lb/hr

$$E_{97} = \frac{\left[8.38(.305) + (9.8)(.305) + 10.0(.39)\right] [illegible]}{675.7} = \frac{(2.555 + 2.989 + 3.9)([illegible])}{675.7}$$

$$\boxed{E_{97} = 37.9 \ \text{lb}/1000 \text{ gal}}$$

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Project Number - 32391 New Source Performance Standards

Computation Sheet For Industrial Factors

Calculations Done By K. Towes Date 3/3/75

Source Pharmaceuticals

There is very little specific information regarding hazardous chemical emissions from pharmaceutical plants. We define mercury as the primary hazardous chemical emission. However it should be noted that potentially there are more, but no emission information could be found on emissions other than mercury.

We also assume that the emission of mercury (Hg) will correspond to the growth in the production of the pharmaceutical industry as a whole. Ref 095 x gives a graph showing growth in the production of pharmaceuticals. From this graph we determine the growth rate of the pharmaceutical industry according to the following equation:

$$P_{c \atop \text{compound}} = \sqrt[(1966-1954)]{\frac{\text{Production 1966}}{\text{Production 1954}}} - 1.0$$

$$= \sqrt[12]{\frac{186 \times 10^6 \text{ lbs}}{66 \times 10^6 \text{ lbs}}} - 1.0 = .0897$$

$$\boxed{P_{c \atop \text{compound}} = .090}$$

No specific information regarding the fractional utilization of the pharmaceutical industry so we assume it corresponds to the figure given by Ref 110, p.145, Table 1 for the chemical manufacturing industry as a whole ⟶ .83

$$\boxed{K_1 = 0.83}$$

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Project Number - 32391 New Source Performance Standards

Computation Sheet For Industrial Factors

Calculations Done By K. Tower Date 9/3/75

Source Pharmaceuticals

Ref 095X gives the 1966 production of pharmaceuticals as 185×10^6 lbs/yr. We calculate A as follows:

$$A = \frac{Prod_{1975}}{K} = \frac{Prod_{1966}\,(1 + P_c)^{1975-1966}}{K}$$

$$= \frac{(185 \times 10^6 \text{ lbs})(1.090)^9}{(0.83)(2000 \text{ lbs/TON})} = .242 \times 10^6 \ \frac{\text{TONS}}{\text{YR}}$$

$$\boxed{A = .24 \times 10^6 \ \frac{\text{TONS}}{\text{YR}}}$$

From Ref 027, p.33, the allowable IRS guideline for "manufacture of chemicals and allied products ..." is 11 years. Assuming twice the allowable:

$$P_B = \frac{1}{2(11)} = 0.045$$

$$\boxed{P_{B_{\text{simple}}} = 0.045_{\text{simple}}}$$

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Computation Sheet For Emission Factors

Calculations Done By K. Towse Date 9/3/75

Source Pharmaceuticals

Ref 230, p. 7-9, Table 7-3 states that within the pharmaceutical industry 400 lbs Hg are emitted to the atmosphere for every ton of Hg used. Ref 270, p. 28 states that the U.S consumed 5.5×10^6 lbs Hg in 1966 and that 5% of this amount was used by the pharmaceutical industry (Ref 270, p. 32). In addition the U.S. capacity for the production of pharmaceuticals is $.24 \times 10^6 \frac{\text{TONS}}{\text{YR}}$ (in 1966), as previously calculated. The uncontrolled emission factor for Hg can be calculated as follows:

$$E_U = \frac{\left(400 \frac{\text{lbs Hg emitted}}{\text{TON Hg used}}\right)\left(5.5 \times 10^6 \text{ lbs Hg}\right)\left(.05\right)}{\left(.24 \times 10^6 \text{ TONS}_{\text{pharmaceuticals}}\right)\left(2000 \frac{\text{lbs}}{\text{TON}}\right)} = .229 \frac{\text{lbs Hg emitted}}{\text{TON Pharm. produced}}$$

$$\boxed{E_U = .229 \frac{\text{lbs Hg emitted}}{\text{TON Pharm. produced}}}$$

Ref 216, p. 501 states that mercury vapors may be controlled by adsorption on iodine-impregnated carbon. No typical efficiencies could be found, however we will assume an 80% efficiency is possible.

$$E_N = \left(.229 \frac{\text{lbs}}{\text{TON}}\right) \times \left(0.20\right) = .046 \frac{\text{lbs}}{\text{TON}}$$

$$\boxed{E_N = .046 \frac{\text{lbs Hg emitted}}{\text{TON Pharm. produced}}}$$

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Computation Sheet For Emission Factors

Calculations Done By K. Tower Date 2/4/75

Source Pharmaceuticals

There are no specific state regulations limiting there emission of mercury into the atmosphere. We therefore assume $E_S = E_N$.

$$\boxed{E_S = .229 \frac{\text{lbs Hg emitted}}{\text{Ton Pharm. produced}}}$$

Since carbon adsorption system can generally be retrofit to existing plants we assume $E_{111D} = E_N$

$$\boxed{E_{111D} = .046 \frac{\text{lbs Hg emitted}}{\text{Ton Pharm produced}}}$$